MAHENDRA ENGINEERING COLLEGE
Autonomous| Accredited by NAAC with 'A++' Grade (Cycle-2)
Accredited by NBA Tier-I (WA) UG : CSE, ECE, EEE
Mahendhirapuri, Mallasamudram (W), Namakkal (Dt) - 637 503, Tamil Nadu
04288-288 500 / 521 / 522 | www.mahendra.info

B.E. MECHATRONICS ENGINEERING

CURRICULUM

REGULATION-2022

CHOICE BASED CREDIT SYSTEM (CBCS)

ABOUT THE DEPARTMENT

- Established in the year 2013 with the intent of raising qualified Mechatronics Engineers who can make substantial contribution to the field of Mechanical, Electronics, Computer and Electrical Engineering.
- Alumni strength of more than 100 and they are working in reputed National and International Organizations.
- 4 Faculty members have registered for Ph.D. program.
- Publications in many National and International indexed Journals.
- Specially designed skill development programmes with support of industrial experts.
- Placement in many companies.
- Various technical clubs such as Design club and Product development club are actively functioning to impart specialized knowledge and skills to the students in various domains.

PROGRAMMES OFFERED

B.E. – Mechatronics Engineering- 4 years

VISION AND MISSION:

Vision

- To achieve excellence in the field of Mechatronics engineering education, research and innovative product development.

Mission

- To offer high-quality application-oriented education and prepare our graduates to become innovators in their profession
- To provide exposure to latest technologies through industry - institute interaction.
- To motivate the students towards interdisciplinary research to cater to the local and global needs.
- To encourage innovation leading to development of industrial products with social responsibility.

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PEOs, POs and PSOs:

Programme Educational Objectives (PEOs)

PEO-1: Apply analytical skills and modeling methodologies to recognize, analyze, synthesize and implement operational solutions to engineering problems, product design and development, and manufacturing.

PEO-2: Design and develop the real – world Mechatronics products and processes for various applications.

PEO-3: Lead and contribute in a team entrusted with professional, social, ethical and entrepreneurial responsibilities.

Program Outcomes (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs)

Engineering Graduates will be

PSO-1: Have ability to select appropriate sensors, actuators and control systems depending on application requirement for Industrial automation, Process control, Automotive electronics and MEMS.

PSO-2: Design and develop Mechatronics systems to solve the complex engineering problem by integrating Electronics, Electrical, Mechanical and Control & information systems.

PSO-3: Apply the specific knowledge for design and development of IoT, IIoT systems and Industrial robotics.

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Regulation 2022							
I Semester							
Sl. No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22EN11001R	Communicative English	HS	3	0	0	3
2	22MA12101R	Engineering Mathematics- I	BS	3	1	0	4
3	22CY12001R	Chemistry for Engineering	BS	3	0	0	3
4	22ME33201	Engineering Graphics and Design	ES	3	0	2	4
5	22EE13102	Fundamentals of Electrical and Electronics Engineering	ES	3	0	0	3
6	22HS11001	Heritage of Tamils	MC	1	0	0	1
7	22SH61101	Induction Program	MC	-	-	-	-
PRACTICAL							
8	22CY22001	Chemistry Laboratory	BS	0	0	3	1.5
9	22HS21001	Personality Development Practice Laboratory	HS	0	0	2	1
10	22EE23101	Fundamentals of Electrical and Electronics Engineering Laboratory	ES	0	0	3	1.5
		TOTAL		**16**	**1**	**10**	**22**

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Regulation 2022							
II Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MA12201R	Engineering Mathematics – II	BS	3	1	0	4
2	22PY12001R	Engineering Physics	BS	3	0	0	3
3	22CS13001	Problem Solving Techniques	ES	3	0	0	3
4	22GE13201	Engineering Mechanics	PC	3	0	0	3
5	22MT14201	Electronic Devices and Circuits	PC	3	0	0	3
6	22HS11002	Tamils and Technology	HS	1	0	0	1
PRACTICAL							
7	22PY22001	Physics Laboratory	BS	0	0	3	1.5
8	22CS23001	Problem Solving Techniques Laboratory	ES	0	0	3	1.5
9	22GE24201	Computer Aided Drafting and Modeling Laboratory	PC	0	0	3	1.5
		TOTAL		**16**	**1**	**9**	**21.5**

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Regulation 2022							
III Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MA12303	Differential Equations and Numerical Methods	BS	3	1	0	4
2	22MT14301	Strength of Materials for Mechatronics	PC	3	1	0	4
3	22MT14302	Basics of Fluid Mechanics and Machinery	PC	3	0	0	3
4	22MT14303	Electrical Drives and Actuators	PC	3	0	0	3
5		Open Elective – 1	OE	3	0	0	3
6	22SH11006	Universal Human Values	HS	3	0	0	3
PRACTICAL							
7	22MT24301	Strength of Materials Laboratory	PC	0	0	3	1.5
8	22MT24302	Fluid Mechanics and Machinery Laboratory	PC	0	0	3	1.5
9	22MT24303	Electrical Drives and Actuators Laboratory	PC	0	0	3	1.5
		TOTAL		**18**	**2**	**9**	**24.5**

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Regulation 2022							
IV Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MT14401	Kinematics and Dynamics of Machinery	PC	3	0	0	3
2	22MT14402	Manufacturing Technology	PC	3	1	0	4
3	22MT14403	Digital Principles and System Design	PC	3	0	0	3
4		Professional Elective – 1	PE	3	0	0	3
5	22AE15405	Basics of Mechanical Science	PE	3	0	0	3
6	22MA12405	Numerical Logical and Visual Reasoning Skills	OE	3	0	0	3
7	22CY11001	Environmental Science	BS	3	-	-	-
PRACTICAL							
8	22MT24401	Dynamics Laboratory	PC	0	0	3	1.5
9	22MT24402	Manufacturing Technology Laboratory	PC	0	0	3	1.5
10	22EN60001	Professional Communication Skills	EEC	0	1	1	2
TOTAL				**21**	**2**	**7**	**24**

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Regulation 2022							
V Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MT14501	Applied Hydraulics and Pneumatics	PC	3	1	0	4
2	22MT14502	Microprocessor and Microcontroller	PC	3	0	0	3
3	22MT14503	Automotive Electronics	PC	3	0	0	3
4		Professional Elective – 2	PE	3	0	0	3
5	22MA12501	Interpretation Analysis and Critical Thinking Skills	OE	3	0	0	3
6		Open Elective – 4	OE	3	0	0	3
PRACTICAL							
7	22MT24501	Automation Laboratory	PC	0	0	3	1.5
8	22MT24502	Microprocessor and Microcontroller Laboratory	PC	0	0	3	1.5
9	22EN60002	Interview Skills and Soft Skills	EEC	0	1	2	2
		TOTAL		**18**	**2**	**8**	**24**

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Regulation 2022							
VI Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MT14601	Programmable Logic Controller & its Applications	PC	3	1	0	4
2	22MT14602	Virtual Instrumentation	PC	3	0	0	3
3	22MT14603	Automation in Food Processing and Technology	PC	3	0	0	3
4	22MBATS06	Managerial Skills, Project and Quality Management	HS	3	0	0	3
5		Professional Elective – 3	PE	3	0	0	3
6		Open Elective – 5	OE	3	0	0	3
7	22MC60001	Constitution of India	MC	3	-	-	-
PRACTICAL							
8	22MT24601	PLC Laboratory	PC	0	0	3	1.5
9	22MT24602	Virtual Instrumentation Laboratory	PC	0	0	3	1.5
10	22MT34601	Presentation Skills and Technical Seminar	EEC	0	0	2	1
		TOTAL		**18**	**1**	**7**	**23**

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

Regulation 2022							
VII Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MT14701	Robotics and Industrial Automation	PC	3	1	0	4
2	22MT14703	Automation in Textile Industry	PC	3	0	0	3
3	22MT14704	CNC Machining Technology	PC	3	0	0	3
4		Professional Elective- 4	PE	3	0	0	3
5		Professional Elective- 5	PE	3	0	0	3
6		Professional Elective- 6	PE	3	0	0	3
PRACTICAL							
7	22MT24701	Robotics Laboratory	PC	0	0	3	1.5
8	22MT24702	Computer Aided Design and Analysis Laboratory	PC	0	0	3	1.5
9	22MT34701	Project Work (Phase - 1)	EEC	0	0	6	3
		TOTAL		**15**	**0**	**12**	**25**

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

Regulation 2022							
VIII Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
PRACTICAL							
1	22MT34801	Project Work (Phase – 2)	EEC	0	0	9	6
		TOTAL		**0**	**0**	**9**	**12**

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Mallasamudram, Namakkal

SUBJECT CATEGORY	CREDITS AS PER SEMESTER								Credit Total	% of Credits (Actual Credits /Total Credits)
	I	II	III	IV	V	VI	VII	VIII		
HS	**4**	**-**	**3**	**-**	**3**	**-**	**-**	**-**	**10**	**6.09**
BS	**8.5**	**8.5**	**4**	**-**	**-**	**-**	**-**	**-**	**21**	**12.80**
ES	**8**	**4.5**	**-**	**-**	**-**	**-**	**-**	**-**	**12.5**	**7.62**
PC	**-**	**7.5**	**14.5**	**10**	**10**	**11.5**	**16**	**-**	**69.5**	**42.37**
PE	**-**	**-**	**-**	**3**	**3**	**3**	**3**	**6**	**18**	**10.97**
OE	**-**	**-**	**3**	**6**	**6**	**3**	**-**	**-**	**18**	**10.97**
EEC	**-**	**-**	**-**	**2**	**2**	**2**	**3**	**6**	**15**	**9.14**
Non-Credit / Mandatory (MC)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Total	**20.5**	**20.5**	**24.5**	**21**	**24**	**19.5**	**22**	**12**	**164**	**99.96**

Legends Used:

1. HS-Humanities and Social Sciences
2. BS -Basic Sciences
3. ES -Engineering Sciences
4. PC-Professional Core
5. PE-Program Elective
6. OE-Open Elective
7. EEC – Employability Enhancement Course
8. MC – Mandatory Course

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PROFESSIONAL ELECTIVES

Sl. No.	Subject Code	Subject Name	Category	L	T	P	C
1	22MT15001	Sensors and Signal Processing	PE	3	0	0	3
2	22MT15002	Computer Aided Design	PE	3	0	0	3
3	22MT15003	Micro Electro Mechanical Systems	PE	3	0	0	3
4	22MT15004	Machine Vision and Image Processing	PE	3	0	0	3
5	22MT15005	Artificial Intelligence	PE	3	0	0	3
6	22MT15006	Engineering Economics and CostAnalysis	PE	3	0	0	3
7	22MT15007	Engineering Materials and Metallurgy	PE	3	0	0	3
8	22MT15008	Product Design and Development	PE	3	0	0	3
9	22MT15009	Safety Engineering	PE	3	0	0	3
10	22MT15010	Power Electronics	PE	3	0	0	3
11	22MT15011	Smart Manufacturing	PE	3	0	0	3
12	22MT15012	Design of Mechatronics Systems	PE	3	0	0	3
13	22MT15013	Industrial Electronics andApplications	PE	3	0	0	3
14	22MT15014	Embedded Systems Design	PE	3	0	0	3
15	22MT15015	Medical Mechatronics	PE	3	0	0	3
16	22MT15016	Engineering Thermodynamics	PE	3	0	0	3
17	22MT15017	Maintenance Engineering	PE	3	0	0	3
18	22MT15018	Entrepreneurship Development	PE	3	0	0	3

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

19	22MT15019	Quality Control and ReliabilityEngineering	PE	**3**	**0**	**0**	**3**
20	22MT15020	Renewable and Non-RenewableEnergy Resources	PE	**3**	**0**	**0**	**3**
21	22MT15021	Building Automation	PE	**3**	**0**	**0**	**3**
22	22MT15022	Modeling and Simulation	PE	**3**	**0**	**0**	**3**

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

I SEMESTER

Regulation 2022							
I Semester							
Sl. No.	**Course Code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22EN11001	Communicative English	HS	3	0	0	3
2	22MA12101	Engineering Mathematics- I	BS	3	1	0	4
3	22CY12001	Chemistry for Engineering	BS	3	0	0	3
4	22GE13001	Engineering Graphics and Design	ES	3	0	2	4
5	22EE13102	Fundamentals of Electrical and Electronics Engineering	ES	3	0	2	4
		Induction Program	MC	-	-	-	-
PRACTICAL							
6	22CY22001	Chemistry Laboratory	BS	0	0	3	1.5
7	22EN21001	Personality Development Practice Laboratory	HS	0	0	2	1
		TOTAL		**15**	**1**	**9**	**20.5**

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code	1101

I Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22EN11001	COMMUNICATIVE ENGLISH	3	0	0	3	100

Objective(s)	To enable the students to: • To help learners to improve their knowledge of grammar. • To enable them to use vocabulary appropriately in different academic and professional contexts. • To support learners to acquire listening and speaking skills. • To facilitate them to develop their reading skills by familiarizing different types of reading strategies. • To equip them with writing skills needed for academic as well as professional context.
Outcome(s)	At the end of the course, learners will be able to • Recognize and comprehend the professional materials in English • Develop vocabulary skills and use words appropriately in different academic contexts. • Analyze and interpret the data with correct usage of grammar • Acquire effective LSRW skills with emerging technology • Demonstrate strong communication skills in both personal and professional life

UNIT - I	**(9)**

Listening- Listening to Short Conversations (Formal and Informal).
Speaking – Introducing Oneself and Others.
Reading – Skimming and Scanning-Reading Comprehension Passages and Answering Multiple Choice Questions.
Writing - Leave/On Duty application, Bonafide Certificate-requisition, Check list, Instructions.
Grammar & Vocabulary – Parts of Speech, Articles, Prefixes and Suffixes.

UNIT - II	**(9)**

Listening – Listening to Telephonic Conversations.
Speaking –Greetings and Welcome Address.
Reading – Predicting the Content of a Given Article – Newspaper Articles.
Writing- Recommendations, Composing E-Mail, Letter Writing- Invitation letter.
Grammar & Vocabulary – Sentence Pattern, Tenses, British Terms and American Equivalents.

UNIT – III	**(9)**

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

Listening - Listening to Talks and Note taking. **Speaking** – Role Play. **Reading** –Cloze Reading and Fill up the Gaps. **Writing** - Letter Writing – Permission Letter (In-Plant Training/Industrial Visit), Business letters- Calling for Quotation and Placing Order. **Grammar & Vocabulary** –If Conditionals, Abbreviations and Acronyms.		
UNIT – IV		**(9)**
Listening - Listening to Situation Based Dialogues. **Speaking** – Talking part in Casual Conversation. **Reading** - Reading Advertisements. **Writing** – Paragraph Writing, and Job Application. **Grammar & Vocabulary** – Concord, Gerunds and Infinitives, Synonyms and Antonyms.		
UNIT - V		**(9)**
Listening – Listening to Academic lectures. **Speaking** - Describing Objects. **Reading** – Transcoding (Conversion of Flow Chart, Bar chart, Pie chart into a paragraph). **Writing** –Review writing (Films & Books), Essay Writing. **Grammar & Vocabulary** – Modal Verbs, Voice- Active Voice, Passive Voice and Impersonal Passive, Question tags and Nominal Compounds.		
	Total hours to be taught	**45 Periods**

TEXT BOOK :	
1	N.P.Sudharshana and C.Savitha, *English For Technical Communication*, Cambridge University Press, New Delhi, 2016.
2	Murphy, Raymond, *English Grammar in Use*, Fifth Edition. Cambridge University Press, New Delhi, 2019.
REFERENCE:	
1	Meenakshi Raman and Sangeeta Sharma., *Technical Communication: Principles and Practice, Third Edition*. OUP, New Delhi, 2015.
2	Ashraf Rizvi. *Effective Technical Communication*, Tata McGraw Hill, 2017.
3	Jack C. Richards with Jonathan Hull and Susan Proctor, *Interchange*. 4th Edition, Cambridge University Press, New Delhi, 2016.
Extensive Reading:	
1	Khera, Shiv. *You can Win*. Macmillan, Delhi. 1998.

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Websites:	
1	http://www.englishclub.com
2	http://www.talkenglish.com
3	https:// www.ted.com/talks
4	https://nptel.ac.in/

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Mallasamudram, Namakkal

Department	Mechatronics				Programme Code	1101
I Semester						
Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MA12101	ENGINEERING MATHEMATICS- I	3	1	0	4	100

Objective(s)	To enable the students to: • Learn the types of matrices and linear algebra in a comprehensive manner. • Familiarize with functions of several variables, which is applied in electrical andcommunication branch engineering. • Define the geometric aspects of curvature, radius of curvature, evolutes and envelopesas application of differential calculus. • Explain different types of higher order ordinary differential equations with variable coefficients and various methods to solve the equations. • Learn the double and triple integrals and give their representation as area and volume.
Outcome(s)	At the end of the course the students will be able to: • Solve the system of equations and determine rank, Eigen values, Eigen vectors and inverse of a given matrix and diagonalise symmetric matrix by orthogonal transformations. • Illustrate maxima and minima functions of several variables. • Apply the concepts of differential calculus in physical problems. • Solve the higher order differential equations with variable coefficients. • Compute the area and volume by using multiple integrals.

UNIT-I	MATRICES	(9+3)
Matrix and its types – Rank of matrix - Characteristic equation - Eigen values and Eigen vectors of the matrix - Cayley-Hamilton Theorem, Diagonalization of real and symmetric matrices by Orthogonal transformation – Reduce the quadratic form to canonical form.		
UNIT-II	**DIFFERENTIAL CALCULUS OF SEVERAL VARIABLES**	**(9+3)**
Differentiation of implicit functions – Partial derivatives – Total derivative – Euler's theorem – Jacobian and properties – Taylor's series for functions of two variables – Maxima and minima of functions of two variables – Lagrange's method of undetermined multipliers.		

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

UNIT-III	**APPLICATIONS OF DIFFERENTIAL CALCULUS**	**(9+3)**
Curvature in Cartesian co-ordinates– Centre and radius of curvature – Circle of curvature – Evolutes – Envelopes – Evolute as envelope of normals and their properties.		
UNIT-IV	**ORDINARY DIFFERENTIAL EQUATIONS OF HIGHER ORDERS**	**(9+3)**
Second and Higher order linear differential equations with constant coefficients – Method of variation of parameters – Cauchy Euler equation, Legendre's type differential equations – System of simultaneous linear differential equations with constant coefficients.		
UNIT-V	**MULTIPLE INTEGRALS**	**(9+3)**
Double integrals in Cartesian co-ordinates – Change of order of integration – Area as double integral – Triple integral in Cartesian co-ordinates – Volume as triple integral – Change of variables in double integrals.		
	Total hours to be taught	**(L:45+T:15): 60 Periods**

TEXT BOOKS:

1	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2018.
2	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.
3	G.Balaji, Engineering Mathematics – I, G.Balaji Publication, 3rd Edition, 2015.

REFERENCE:

1	G.B. Thomas and R.L. Finney, Calculus and Analytic geometry, 9th Edition, Pearson, Reprint, 2002.
2	Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2016.
3	Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2016.
4	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Ninth Edition,2014.

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Department	Mechatronics	Programme Code	1101

I Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22CY12001	CHEMISTRY FOR ENGINEERING	3	0	0	3	100

Objective(s)

To make the students familiar with :

- The treatment of water for potable and industrial purposes.
- Provides students with an opportunity to identify different types of polymers in our surroundings.
- The basic principles and preparatory method of Nanomaterial.
- Different types of batteries with Construction and application.
- The principles of corrosion and control techniques.

Outcome(s)

At the end of the course the student will be able to

- Explain the basic principles of water quality parameters, their analysis and various water treatments Process for domestic and industrial applications.
- Classify the reaction mechanism, synthesis and application of polymers.
- Develop the basic concepts of nanoscience and nanotechnology in designing the nanomaterial for Engineering and Technology.
- Compare the working principles of batteries and Super capacitors with recycling methods.
- Inspect the principles of corrosion in metals with control measures.

UNIT-I **WATER TECHNOLOGY** (9)

Water: Sources and impurities - Water quality parameters - Definition and significance of - colour, odour, turbidity, pH, hardness, alkalinity, flouride and arsenic - Domestic water treatment – disinfection methods (Chlorination, ozonation, UV treatment) – Boiler feed water – requirements – Decreased efficiency of using hard water in boilers – external conditioning – demineralization process, Electro dialysis process, reverse osmosis - Internal conditioning (phosphate, calgon and carbonate conditioning methods) – WHO and BIS guidelines for drinking water.

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Mallasamudram, Namakkal

UNIT-II	**POLYMER CHEMISTRY**	(9)
Introduction: Classification of polymers – Natural and synthetic - Thermoplastic and Thermosetting - Functionality – Degree of polymerization - Types and mechanism of polymerization: Addition (Free Radical); condensation and copolymerization - Properties of polymers: Tg, Tacticity, Molecular weight - weight average, number average and polydispersity index - Preparation, properties & applications of selected commodity and engineering polymers (Polystyrene, Teflon, Bakelite and Epoxy resin).		
UNIT-III	**NANOCHEMISTRY**	(9)
Introduction: Basics - difference between molecules, nanoparticles and bulk materials - size-dependent properties (optical, electrical, mechanical and magnetic) - Types of nanomaterials: Definition, properties and uses of –nanoparticles , nanocluster, nanorod, nanotube and nanowire - Synthesis of nanomaterials: laser ablation, Chemical vapour deposition, electro deposition, precipitation, hydrothermal - Applications (Medicine, Agriculture and Electronics).		
UNIT-IV	**ENERGY STORAGE DEVICE**	(9)
Types of batteries - Primary battery - dry cell - Secondary battery - lead acid battery and Lithium ion batteries- Fundamentals, Construction and application - Thin Film solid state batteries – Recycling of Na-Air batteries – Battery used in EV application - Super Capacitors(Storage principle and types).		
UNIT-V	**CORROSION & ITS CONTROL**	(9)
Corrosion: Chemical corrosion – Pilling Bedworth rule – electrochemical corrosion – different types – galvanic corrosion – differential aeration corrosion - Vapour Deposition Techniques - Physical and Chemical Vapour Deposition – factors influencing corrosion – corrosion control – sacrificial anode and impressed cathodic current methods – corrosion Inhibitors.		
	Total hours to be taught	**45 Periods**

TEXT BOOKS :

1.	Jain P.C. and Monica Jain, "Engineering Chemistry", Dhanpat Rai Publishing Company (P) Ltd., New Delhi, 2010.
2.	Dr.C.K.Charles and Dr.G.Ramachandran, "Applied Chemistry", CARS Publishers, Chennai, 2015.
3.	David Linden and Thomas B. Reddy "Handbook of Batteries", Third Edition McGraw-Hill New York.

REFERENCE:

1.	Dara S.S, Umare S.S, "Engineering Chemistry", S. Chand & Company Ltd., New Delhi 2010.
2.	Sivasankar B., "Engineering Chemistry", Tata McGraw-Hill Publishing Company, Ltd., New Delhi, 2008.
3.	Kannan P., Ravikrishnan A., "Engineering Chemistry", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2009.

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Department	Mechatronics	Programme Code			1101	
I Semester						
Course code	Course Name	Hours/week			Credit	Maximum marks
22GE13001	ENGINEERING GRAPHICS AND DESIGN	L	T	P	C	100
		3	0	2	4	

Objective(s)

To make the students familiar with :

- Increase ability to communicate with people through drawing skills as per the BIS standard.
- Learn to sketch and take field dimensions.
- Learn to take data and transform it into graphic drawings.
- Learn basic Auto Cad skills.
- Learn basic Engineering Drawing formats.

Outcome(s)

At the end of the course the student will be able to

- Indicate proper dimensions on drawings will improve
- Perform basic sketching techniques will improve.
- Familiar with office practice and standards.
- Familiar with Auto Cad two dimensional drawings.
- Improve their visualization skills so that they can apply these skills in developing new products.

EXAMINATION PATTERN: THEORETICAL MODE

UNIT-I PLANE CURVES AND FREE HAND SKETCHING (9)

Curves used in engineering practices:

Conics – Construction of ellipse, Parabola and hyperbola by eccentricity method – Construction of cycloid – construction of involutes of squad and circle – Drawing of tangents and normal to the above curves.

Free hand sketching:

Representation of Three Dimensional objects – General principles of orthographic projection – Need for importance of multiple views and their placement – First angle projection – layout views – Developing Visualization skills through free hand sketching of multiple views from pictorial views of objects.

UNIT-II PROJECTION OF POINTS, LINES AND PLANE SURFACES (9)

Projection of points and straight lines located in the first quadrant – Determination of true lengths and true inclinations – Projection of polygonal surface and circular lamina inclined to both reference planes.

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EXAMINATION PATTERN: PRACTICAL MODE		
UNIT-III	**PROJECTION OF SOLIDS**	**(9)**
Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one reference plane by change of position method.		
UNIT-IV	**SECTION OF SOLIDS AND DEVELOPMENT OF SURFACES**	**(9)**
Sectioning of above solids in simple vertical position when the cutting plane is inclined to the one of the principal planes and perpendicular to the other – obtaining true shape of section. Development of lateral surfaces of simple and sectioned solids – Prisms, pyramids cylinders and cones. Development of lateral surfaces of solids with cut-outs and holes.		
UNIT-V	**ISOMETRIC AND PERSPECTIVE PROJECTIONS**	**(9)**
Principles of isometric projection – isometric scale – isometric projections of simple solids, truncated prisms, pyramids, cylinders and cones. Perspective projection of prisms, pyramids and cylinders by visual ray method.		
	Total hours to be taught	**45 Periods**

List of Equipments:

1. Better hardware, with suitable graphics facility -30 No
2. Licensed software for Drafting and Modeling. - 30 Licenses
3. Laser Printer or Plotter to print / plot drawings - 1 No

TEXT BOOKS:

1	N S Parthasarathy and Vela Murali, "Engineering Drawing" Oxford University Press 2015.
2	K. Venugopal & V. Prabhu Raja, "Engineering Graphics", New Age International (P) Limited, 2011.
3	K. V. Natrajan, "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2012.
4	M.S. Kumar, "Engineering Graphics", D.D. Publications, 2010.

REFERENCE:

1	M.B. Shah and B.C. Rana, "Engineering Drawing", Pearson Education 2005.
2	K. R. Gopalakrishnana, "Engineering Drawing" (Vol.I&II), Subhas Publications 1998.
3	Basant Agarwal and Agarwal C.M., "Engineering Drawing", Tata McGraw Hill Publishing Company Limited, New Delhi, 2008.
4	Dhananjay A.Jolhe, "Engineering Drawing with an introduction to AutoCAD" Tata McGraw Hill Publishing Company Limited 2008.

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Department	Mechatronics				Programme Code	1101
I Semester						
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22EE13102	FUNDAMENTALS OF ELECTRICAL AND ELECTRONICS ENGINEERING (Integrated Course)	3	0	2	4	100

Objective	To make the students familiar with : • To learn the concepts of DC circuits and wiring connections. • To understand the basic concepts of Semiconductor Device • To develop skills to interface I/O devices such as keyboard, display, Traffic light, Programmable Interrupt Controller, ADC and DAC with 8051
Outcomes	At the end of the course the student will be able to • Illustrate the concepts of DC circuits to compute Voltage, Current and Resistance • Describe the constructional features and working principle of Electrical machines • Discuss the characteristics and control schemes of Electrical drives • Explain the functions of semiconductor devices and microcontrollers • Design the microcontroller based systems for practical applications

UNIT I	BASIC CIRCUITS AND DOMESTIC WIRING	(9)

Electrical circuit elements (R, L and C)-Dependent and independent sources – Ohm's Law- Kirchhoff's laws - mesh current and node voltage methods (Analysis with only independent source) - Phasors – RMS-Average values-sinusoidal steady state response of simple RLC circuits. Types of wiring- Domestic wiring - Specification of Wires-Earthing-Methods-Protective devices.

UNIT II	ELECTRICAL MACHINES AND DRIVES	(9)

DC generator Constructional details – EMF equation- Methods of excitation- Principle of operation of D.C. motor – Back EMF and torque equation – Starting of D.C. motors – Three phase and Single phase induction motors(only qualitative treatment)- Types of Electric Drives- Speed-Torque characteristics of various types of load and drive motors- Speed Control Of Electrical Drives(Qualitative Approach Only)

UNIT III	SEMICONDUCTOR DEVICES AND MICROCONTROLLERS	(9)

Basic Electronic Components: Resistance - Inductor - Capacitor -Types, Functions, Symbols - Color coding of Resistance – Review of insulator, conductor and semiconductor -Semiconductor types – Drift and Diffusion Currents - Study of CRO- Construction of PN junction diode- V-I characteristics of PN junction diode- Zener diode as voltage regulator – Biasing LED- Switch mode Power Supply-8051 Architecture and Programming- PIC Microcontroller

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LIST OF EXPERIMENTS		
1	Assembly Language Programming for arithmetic operations using 8051	**(18)**
2	Assembly Language Programming for control instruction (Increment/Decrement, Ascending/ Descending order) using 8051	
3	Traffic Light Interface	
4	Keyboard Interface	
5	Display Interface	
6	Stepper motor controller interface	
	Total Hours to be taught	**45 Hours**
Text Books:		
1	Charles K. Alexander and Mathew N.O. Sadiku, Fundamentals of Electric Circuits, 5th edition, McGraw-Hill,2019.	
2	Joseph Edministor and Nahvi (Mohmood), 'Theory & Problems of Electric Circuits', 5th edition, McGraw Hill, 2020.	
3	V.K Mehta and Rohit Mehta, 'Principle of Electrical Engineering' S Chand & Company, 2008.	
4	Rajkamal, "Microcontrollers Architecture, Programming Interfacing,& System Design",Pearson,2012	
References		
1	Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Edition, 2006.	
2	J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits", Tata McGraw Hill, 2nd Edition, 2008.	
3	John Iovine, 'PIC Microcontroller Project Book ', McGraw Hill 2000	

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Department	Mechatronics	Programme Code	1101

I Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22CY22001	CHEMISTRY LABORATORY	0	0	3	1.5	100

Objective(s)

To make the students familiar with :

- Educate the theoretical concepts experimentally
- To impart skills in measurements.
- To design and plan the experimental procedure and to record and process the results.
- To reach non trivial conclusions of significant of the experiments.

Outcome(s)

On completion of this course, students will have the knowledge in

- Demonstrate laboratory practices, handling glassware, equipment, and chemical reagents.
- Experiment with different types of instruments for analysis of materials using small quantities involved for quick and accurate results.
- Analyze different types of titrations for estimation of materials using more quantities involved for good results.

LIST OF EXPERIMENTS

1.	Determination of Total, Temporary & Permanent hardness of water using EDTA method.
2.	Determination of the Alkalinity level of a water sample.
3.	Determination of Chloride content of water sample by Argentometry.
4.	Determination of DO content of water sample using Winkler's method.
5.	Determination of Rate of Corrosion of Mild steel by Weight loss method.
6.	Determination of molecular weight of polyvinyl alcohol using Viscometry.
7.	Estimation of Iron content of the given solution using Potentiometry.
8.	Determination of strength of given hydrochloric acid using pH meter.
9.	Conductometric titration a strong acid vs strong base.
10.	Determination of strength of acids in a mixture using Conductometry.

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

11.	Estimation of sulphate in a solution using Conductometry.	
12.	Estimation of iron content of the water sample using Spectrophotometry. (1,10-phenanthroline / thiocyanate method) – (**DEMO ONLY**)	
	Total hours to be taught	**45 Periods**
TEXT BOOK		
1.	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2019.	
2.	Chemistry lab Manual, Department of Chemistry, Mahendra Engineering College, Mallasamudram, 2017.	
REFERENCE		
1.	Applied chemistry theory and practice by O. P. Vermani and A. K. Narula, second edition.	
2.	Furniss B.S. Hannaford A.J, Smith P.W.G and Tatchel A.R., "Vogel's Textbook of practical organic chemistry", LBS Singapore (1996).	
3.	Kolthoff I.M. and Sandell E.B. et al. Quantitative chemical analysis, Mcmillan, Madras 1980.	

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Department	Mechatronics	Programme Code	1101

I Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22EN21001	Personality Development Practice Laboratory	0	0	2	1	100

Objective(s)	• To develop listening and speaking skills of students for a variety of purposes like making presentations, attending interviews and participating in discussions. • To enhance the non-verbal and social interaction skills of students for becoming effective communicators. • To enable learners to hone their linguistic (LSRW) skills with the help of Technology.
Outcome(s)	**At the end of the course, the students will be able to** ▪ Understand the language proficiency and its techniques. ▪ Prepare the resume with organized details. ▪ Develop soft skills to excel in their career.

LIST OF EXERCISES

1.	Introduction to LSRW Skills
2.	Listening Comprehension
3.	Reading Comprehension
4.	Common Errors in English
5.	Interview Skills
6.	Presentation skills
7.	Body Language
8.	Group Discussion
9.	Soft Skills
10.	Innovation and Creative Writing
Total hours to be taught	**45 Periods**

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II SEMESTER

Regulation 2022							
II Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MA12201R	Engineering Mathematics – II	BS	3	1	0	4
2	22PY12001R	Engineering Physics	BS	3	0	0	3
3	22CS13001	Problem Solving Techniques	ES	3	0	0	3
4	22GE13201	Engineering Mechanics	PC	3	0	0	3
5	22MT14201	Electronic Devices and Circuits	PC	3	0	0	3
6	22HS11002	Tamils and Technology	HS	1	0	0	1
PRACTICAL							
7	22PY22001	Physics Laboratory	BS	0	0	3	1.5
8	22CS23001	Problem Solving Techniques Laboratory	ES	0	0	3	1.5
9	22GE24201	Computer Aided Drafting and Modeling Laboratory	PC	0	0	3	1.5
		TOTAL		**16**	**1**	**9**	**21.5**

Dr. T.JESUDAS, M.E., Ph.D
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Mahendra Engineering College
Mallasamudram, Namakkal

Department	Mechatronics	Programme Code	1101

II Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MA12201	ENGINEERG MATHEMATICS - II (Common to all Branches)	3	1	0	4	100

Objectives

To enable the students to:

- Define vector function, operators and working procedure to evaluate line , surface and volume integrals.
- Learn Laplace transform, inverse Laplace transform and its properties to solve differential equations.
- Learn about Fourier transforms, inverse Fourier transform and its properties and apply convolution theorem and Parseval's identity to various functions
- Know about functions of a complex variable, properties and problems involving conformal mapping.
- Learn about Taylor's and Laurent's series expansion of complex functions and the process of evaluating complex integrals.

Outcomes

At the end of the course the students will be able to

- Solve problems related to vector differentiation, line, surface and volume integrals and theorems involving them.
- Describe Laplace transform and its properties inverse Laplace transform and the solution of linear differential equation using Lpaplace transform techniques.
- Solve Fourier transforms , inverse Fourier transform and its properties and apply convolution theorem and Parseval's identity to various functions
- Solve Analytic functions, harmonic functions, conformal mapping and its applications.
- Expand the functions as Taylor's and Laurent's series and evaluate the complex integrals.

UNIT-I	VECTOR CALCULUS	(9+3)

Gradient Divergence and Curl – Directional derivative – Irrotational and solenoidal vector fields – Vector integration – Green's theorem in a plane, Gauss divergence theorem and Stokes' theorem (excluding proofs).Verification and application in evaluating line, surface and volume integrals.

UNIT -II	LAPLACE TRANSFORM	(9+3)

Transform, Properties of Laplace Transform, Laplace transform of periodic functions. Finding inverse Laplace transform by different methods, convolution theorem, solving ODEs by Laplace Transform method.

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Mallasamudram, Namakkal

UNIT-III	FOURIER TRANSFORMS	(9+3)
Fourier integral theorem (statement only)-Fourier transform pair (infinite) - Sine and cosine transforms-Properties-Transform of simple functions-Convolution theorem- Parseval's identity.		
UNIT-IV	**ANALYTIC FUNCTIONS**	**(9+3)**
Functions of a complex variable, Cauchy-Riemann equations – Analytic functions – Harmonic and orthogonal properties of analytic function – Harmonic conjugate – Construction of analytic functions – Conformal mapping: w= z+c, cz, 1/z, and Bilinear transformation.		
UNIT-V	**COMPLEX INTEGRATION**	**(9+3)**
Complex integration – Statement and applications of Cauchy's integral theorem and Cauchy's integral formula(without proof) – Taylor and Laurent expansions –Types of Singularities-Singular points – Residues – Residue theorem(without proof) – Application of residue theorem to evaluate real integrals – Contour integration.		
	Total hours to be taught	**(L:45+T:15): 60 Periods**

TEXT BOOKS

1	Veerarajan T., Engineering Mathematics for first year, Tata McGraw-Hill, New Delhi, 2018.
2	B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.

REFERENCE

1	V. Krishnamurthy, V. P. Mainra and J. L. Arora, "An introduction to Linear Algebra", Affiliated East-West presses, 2005.
2	Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2016.
3	Ramana B.V., Higher Engineering Mathematics, Tata McGraw Hill New Delhi, 11th Reprint, 2010.
4.	N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Ninth Edition,2014.

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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code	1101

II Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22PY12101	ENGINEERING PHYSICS (Common to all Branches)	3	0	0	3	100

Objective(s)

To enable the students to:

- To provide students with a fundamental knowledge of physics, together with problem-solving skills
- Understanding of Basics of Physics about lasers, Acoustics, Properties of matter, Semiconductor Physics and Quantum Physics. How these are used in information and communication technology.

Outcome(s)

At the end of the course the students will be able to:

- Understand the basics of Laser, Fiber Optics and its types with its applications in various fields.
- Gain knowledge about Acoustics and Ultrasonic's their applications in various engineering fields.
- Have the necessary understanding on Properties of materials and their uses.
- Get Knowledge on basics concepts of Quantum Physics with their Applications.
- Acquire knowledge on basics of semiconducting materials and their applications in Solar.

UNIT - I **LASER AND FIBER OPTICS** **(9)**

Introduction – Principle of spontaneous emission, stimulated absorption and emission – Einstein's coefficient (derivation) – Types of lasers - CO_2, Nd: YAG – Fiber optics: principle, numerical aperture and acceptance angle - types of optical fibers (material, refractive index and mode) – losses associated with optical fibers - fiber optic sensors: pressure and displacement.

UNIT - II **ULTRASONICS AND ACOUSTICS** **(9)**

Introduction – Production – magnetostriction effect - magnetostriction generator – piezoelectric and inverse piezoelectric effect- piezoelectric generator – properties – Cavitations - Velocity measurement – acoustic grating – SONAR - Non Destructive Testing – pulse echo system through transmission and reflection modes - A, B and C –scan displays.

Classification of sound- decibel- Weber–Fechner law – Sabine's formula- derivation using growth and decay method – Absorption Coefficient and its determination –factors affecting acoustics of buildings and their remedies.

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Mallasamudram, Namakkal

UNIT - III	**PROPERTIES OF MATTER**	**(9)**

Elasticity – Stress-strain diagram and its uses - factors affecting elastic modulus and tensile strength – torsional stress and deformations – twisting couple - torsion pendulum: theory and experiment - bending of beams - bending moment – cantilever: theory and experiment – uniform and non-uniform bending: theory and experiment - I-shaped girders - stress due to bending in beams.

UNIT - IV	**QUANTUM PHYSICS**	**(9)**

Black body radiation – Planck's theory (derivation) –wave particle duality – electron diffraction – concept of wave function and its physical significance – Schrödinger's wave equation – time independent and time dependent equations – particle in a one-dimensional rigid box– scanning tunneling microscope- electron tunneling microscope.

UNIT - V	**SEMICONDUCTOR PHYSICS**	**(9)**

Intrinsic Semiconductors – Energy band diagram – direct and indirect semiconductors – Carrier Concentration in intrinsic semiconductors – extrinsic semiconductors - Carrier concentration in N-type & P-type semiconductors. Photo current in a P- N diode – solar cell –photo detectors - LED – Organic LED – Laser diodes.-Photovoltaic applications: domestic lighting, street lighting, water pumping etc - solar PV power plant.

Total hours to be taught	**45 Periods**

TEXT BOOKS

1.	Dr. Palanisamy P.K, "Engineering Physics", Scitech Publications, Chennai, 2010.
2.	A.S.Vasudeva-Modern Engineering Physics-S.Chand & Co, New Delhi-1998- Second edition 2003.
3.	Wahab, M.A. —Solid State Physics: Structure and Properties of Materials. Narosa Publishing House, 2009.

REFERENCE

1.	Pillai S O, "Engineering Physics", New Age International Publishers, New Delhi, 2005.
2.	Satyaprakash-Engineering Physics-Pragati Prakashan,Meerut-I Edition 2003.
3.	Dr.M.Arumugam-Engineering Physics - Anuradha Agencies, Kumbakonam-III Revised Edition 2002.
4.	D. Halliday, R. Resnick and J. Walker, Fundamentals of Physics, 6th Edition, John Wiley and Sons, 2001.

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Department	Mechatronics	Programme Code	1101

II Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22CS13001	PROBLEM SOLVING TECHNIQUES (Common to all Branches)	3	0	0	3	100

Objectives

To enable the students to:

- Understand the basics of algorithmic problem solving.
- Understand the basic concepts of C Programming.
- Learn the arrays and functions in C.
- Be familiar with pointers and structures in C.
- Understand the file handling techniques and preprocessors in C.

Outcomes

At the end of the course the students will be able to:

- Develop Algorithms for real time problems through various Problem solving techniques.
- Define the syntax of C Programming.
- Summarize the use of functions and pointers in programming in C programming concepts.
- Apply the concepts of pointers and structure.
- Describe the fundamental concepts of files and preprocessors in C.

UNIT-I	PROBLEM SOLVING ASPECTS	(9)

Problem Solving Aspects: Algorithms Pseudo code, Flowchart- Steps In Problem Solving-simple strategies for developing algorithms (iteration, recursion)- Programming methodologies - Illustrative problems: Exchanging The Values-Counting-Find minimum in a list - Factorial Computation - Fibonacci Sequence.

UNIT-II	C PROGRAMMING BASICS	(9)

Introduction to C programming – Header files – Structure of a C program – compilation and linking processes – Constants, Variables – Data Types – Expressions – operators – Input and Output operations – Decision Making and Branching – Looping statements- Programming Examples.

UNIT-III	ARRAYS AND FUNCTIONS	(9)

Arrays: Introduction – One-Dimensional Arrays - Two-Dimensional Arrays - Multidimensional Arrays - Strings: Operations of Strings. Function – definition of function – Declaration of function – Function prototype – Types of functions – Pass by value – Pass by reference – Recursion - Programming Examples

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Mallasamudram, Namakkal

UNIT-IV	**POINTERS AND STRUCTURES**	**(9)**
Pointers - Definition – Initialization - Pointers and arrays- Introduction to Structure – Structure definition – Structure declaration – Structure within a structure- Unions – Storage classes.		
UNIT-V	**FILE PROCESSING AND PREPROCESSORS**	**(9)**
Files: File modes - File functions - File operations - Text and Binary files, Command Line arguments – C Preprocessor directives: Macros – Definition - types of Macros - Creating and implementing user defined header files.		
	Total hours to be taught	**45 Periods**

TEXT BOOK

1	Anita Goel and Ajay Mittal, "Computer Fundamentals and Programming in C", Dorling Kindersley (India)Pvt. Ltd. Pearson Education, 2011.

REFERENCES

1	Dromey R.G, "How to Solve it by Computer" Prentice Hall of India, Delhi., 2010.
2	E Balagurusamy, "Computer Programming", First Edition, Tata McGraw Hill Education (India) Private Ltd, New Delhi., 2013.
3	Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", 2nd Edition, Oxford University Press., 2013.
4	M.Rajaram and P.Uma Maheshwari "Computer Programming with C", Pearson Education., 2013.
5	NPTEL course, Problem Solving Through Programmi Through Programming in C, https://nptel.ac.in/courses/106105171
6	NPTEL course, Introduction to Programming in C, https://nptel.ac.in/courses/106104128

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Mahendra Engineering College
Mallasamudram, Namakkal

Department	Mechatronics	Programme Code	1101

II Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22GE13201	ENGINEERING MECHANICS	3	0	0	3	100

Objective(s)	• To understand the basic concepts required for analyzing static structures model problems using free-body diagrams and accurate equilibrium equations. • To calculate the reactive forces on the structural members. • To know the geometric properties of the different cross sections on the structural members. • To get the exposure on laws of mechanics, work energy and momentum methods for finding the motion parameters..
Outcome(s)	At the end of this course, Student will be able to • Analysis the engineering problems in case of equilibrium conditions. • Calculate the reaction forces of various supports on the structural members. • Evaluate various geometrical properties like centroid, centre of gravity, Moment of Inertia of various surfaces and solids. • Solve the problems involving dynamics of particles and rigid bodies. • Realize about the friction using simple mechanisms.

UNIT-I	**STATICS OF PARTICLE**	**9)**

Introduction to Mechanics – Fundamental Principles – Laws of Mechanics, Lame's theorem, Parallelogram and triangular Law of forces- Vectorial representation of forces and moments, Coplanar forces– Resolution and Composition of forces – Equilibrium of particles - Forces in space - Equilibrium of a particle in space - Equivalent systems of forces - Principle of transmissibility - Single equivalent force.

UNIT-II	**STATICS OF RIGID BODY**	**(9)**

Free body diagram – Types of supports and their reactions-requirements of stable equilibrium – Moments and Couples – Moment of a force about a point and about an axis– Vectorial representation of moments and couples – Scalar components of a moment – Varignon's theorem – Single equivalent force -Equilibrium of Rigid bodies in two dimensions.

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Mallasamudram, Namakkal

UNIT-III	PROPERTIES OF SECTIONS	(9)

Centroid – Rectangular, circular, triangular areas by integration – T section, I section, - Angle section, Hollow section by using standard formula – Theorems of Pappus and Guldinus – Second moment of area — Rectangular, circular, triangular areas by integration – T section, I section, Angle section, Hollow section by using standard formula –Parallel axis theorem and perpendicular axis theorem – Product of inertia of plane areas – Polar moment of inertia – Principal axes.

UNIT-IV	DYNAMICS OF PARTICLES	(9)

Displacements, Velocity and acceleration, their relationship – Relative motion – Curvilinear motion – Newton's law – Work Energy Equation of particles – Impulse and Momentum – Impact of elastic bodies- Impact - direct and central impact – coefficient of restitution. D'Alembert's principle.

UNIT-V	FRICTION	(9)

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction - Rolling resistance. Applications of screw jacks and belts.

Total hours to be taught	**45 Periods**

TEXT BOOKS:

1	R.C. Hibbeller, "Engineering Mechanics – Statics and Dynamics", 11th ed., Pearson Education Asia Pvt. Ltd., 2009.
2	Ferdinand P. Beer, E. Russell Johnston, Vector Mechanics for Engineers: Statics and Dynamics (9th Edition), Tata McGraw-Hill International Edition, 2010.
3	Dr.N.Koteeswaran, "Engineering Mechanics Statics and Dynamics", Sri Balaji Publications 9th Rv.Ed. S.Chand & Co Ltd, 2013.
4	Vela Murali, "Engineering Mechanics", Oxford University Press 2010.

REFERENCE:

1	M.S. Palanichamy and S. Nagam, "Engineering Mechanics – Statics & Dynamics", 3rd ed., Tata McGraw-Hill, 2004.
2	S. Rajasekaran, G. Sankarasubramanian, "Fundamentals of Engineering Mechanics", 3rd ed., Vikas Publishing House Pvt. Ltd, 2009.
3	Kumar, K.L., "Engineering Mechanics", 3rd Revised Edition, Tata McGraw-Hill Publishing company, New Delhi 2008.
4	Irving H. Shames, "Engineering Mechanics – Statics and Dynamics", 4th ed., – Pearson Education Asia Pvt. Ltd., 2005.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

II Semester

Course code	Course Name	Hours/week		Credit		Maximum marks
		L	T	P	C	
22MT14201	ELECTRONIC DEVICES AND CIRCUITS	3	0	0	3	100

Objective(s)	• To understand Kirchoff's Laws, Network theorems and their applications. • To understand the behavior of RL, RC, and RLC circuits under transient conditions. • To distinguish the concept of intrinsic and extrinsic semiconductors, including their doping mechanisms and electrical properties. • To explore the fundamental principles underlying the operation of PNP and NPN transistors. • To recognize the applications of LEDs and LCDs in displays, indicators, and lighting systems.
Outcome(s)	At the end of this course, Student will be able to • Explain Kirchoff's law and Network theorems for their significance in analyzing electric circuits. • Apply the transient responses in RL, RC, and RLC Circuits. • Interpret the current-voltage characteristics of PN junction diodes. • Illustrate the characteristics of CE, CB, and CC transistor configurations and understand their respective applications. • Demonstrate a thorough understanding of the principles of operation and characteristics of special semiconductor devices.

UNIT-I	**CIRCUIT ANALYSIS TECHNIQUES**	**(9)**

Kirchoff's current and voltage laws – series and parallel connection of independent sources – R, L and C – Network Theorems – Thevenin, Superposition, Norton, Maximum power transfer and duality – Star-delta conversion.

UNIT-II	**TRANSIENT RESONANCE IN RLC CIRCUITS**	**(9)**

Basic RL, RC and RLC circuits and their responses to pulse inputs – frequency response – Parallel and series resonances – Q factor – single tuned and double tuned circuits.

UNIT-III	**SEMICONDUCTOR DIODES**	**(9)**

Review of intrinsic & extrinsic semiconductors – Theory of PN junction diode – Energy band structure – current equation – space charge and diffusion capacitances – effect of temperature and breakdown mechanism – Zener diode and its characteristics.

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UNIT-IV	TRANSISTORS	(9)
Principle of operation of PNP and NPN transistors – study of CE, CB and CC configurations and comparison of their characteristics – Breakdown in transistors – operation and comparison of N-Channel and P-Channel JFET – drain current equation – MOSFET – Enhancement and depletion types – structure and operation – comparison of BJT with MOSFET – thermal effect on MOSFET.		
UNIT-V	**SPECIAL SEMICONDUCTOR DEVICES**	**(9)**
Tunnel diodes – PIN diode – SCR characteristics and two transistor equivalent model – Diac and Triac - Photodiode, Phototransistor, Photoconductive and Photovoltaic cells – LED, LCD.		
	Total hours to be taught	**45 PERIODS**

TEXT BOOK :

1	Joseph A. Edminister, Mahmood, Nahri, "Electric Circuits" – Shaum series,Tata McGraw Hill, (2001).
2	S. Salivahanan, N. Suresh kumar and A. Vallavanraj, "Electronic Devices and Circuits",Tata McGraw Hill, 2nd Edition, (2008).
3	David A. Bell, "Electronic Devices and Circuits", Oxford University Press, 5th Edition, (2008).

REFERENCES:

1	Robert T. Paynter, "Introducing Electronics Devices and Circuits", Pearson Education, 7th Education, (2006).
2	William H. Hayt, J.V. Jack, E. Kemmebly and steven M. Durbin, "Engineering Circuit Analysis",Tata McGraw Hill, 6th Edition, 2002.
3	J. Millman & Halkins, Satyebranta Jit, "Electronic Devices & Circuits",Tata McGraw Hill, 2nd Edition, 2008.

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Department	Mechatronics	Programme Code	1101

II Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22PY12001	PHYSICS LABORATORY (Common to All Branches)	0	0	3	1.5	100

Objective(s)	To impart knowledge on • To provide exposure to the students with hands on experience on various basic Applied physics practices for all branches.
Outcome(s)	Upon Completion of the course, the students will be able to: • The hands on exercises undergone by the students will help them to apply physics. • Principles of optics and thermal physics to evaluate engineering properties of materials.

LIST OF EXPERIMENTS

1.	a) Determination of Wavelength, and particle size using Laser. b) Determination of acceptance angle in an optical fiber.
2.	Determination of velocity of sound and compressibility of liquid – Ultrasonic interferometer.
3.	Air Wedge – Thickness of a Wire.
4.	Determination of wavelength of mercury spectrum – spectrometer grating.
5.	Determination of Young's modulus by Non uniform bending method.
6.	Determination of Band Gap of a semiconductor material.
7.	Determination of viscosity of liquid – Poiseuille"s method.
8.	Determination of Young's modulus by Uniform bending method.
9.	Torsional Pendulum – Determination of Rigidity modulus 10.
10.	Spectrometer dispersive power of a prism.
	Total hours to be taught **45 Periods**

REFERENCE:

1.	Physics Laboratory Manual, Department of Physics, Mahendra Engineering College, Namakkal.
2.	Geeta Sanon, BSc Practical Physics, 1st Edn. (2007), R. Chand & Co.
3.	B. L. Worsnop and H. T. Flint, Advanced Practical Physics, Asia Publishing House, New Delhi.
4.	Indu Prakash and Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi.
5.	D. P. Khandelwal, A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication House, New Delhi.

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Department	Mechatronics	Programme Code	1101

II Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22CS23001	PROBLEM SOLVING TECHNIQUES LAB (Common to All Branches)	0	0	3	1.5	100

Objective(s)	The student should be made to: • Understand interfacing components of PC Motherboard. • Expertise in developing applications using Office packages. • Formulate problems and implement algorithms using RS tool.
Outcome(s)	• Identify the interfacing components of PC. • Apply Office packages for specified application creation. • Obtain solutions for the real world problems using Raptor and Scratch tool. • Develop programs using decision making statements, loops and functions. • Apply structures, unions and files using various types of statements for problem solving in C.

LIST OF EXPERIMENTS

1.	Study and Identification of PC Motherboard and Its Interfacing Components.
2.	Prepare A bio-data Using MS Word With Appropriate Page ,Text And Table Formatting Options And Send The Same To Recipients Using Mail Merge.
3.	Create budget planning of your family with cell referencing, formulae, conditional formatting using Excel.
4.	Create a Program flow to illustrate the use of Variables and Constants using Scratch Tool.
5.	Construct flowchart to find the Factorial for a given number Using Raptor.
6.	Students mark generation using decision statements.
7.	Calculator using switch statement.
8.	Prime number generation using looping.
9.	Greatest number using array (one dimensional).
10.	Matrix multiplication using array (two dimensional).
11.	String functions.
12.	Factorial calculation and Fibonacci series using function.
13.	Student mark sheet using structures.
14.	Copy text from one file to other File.
	Total hours to be taught **30 Periods**

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Department	Mechatronics	Programme Code & Name	1101 & MCT

II Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22GE24201	COMPUTER AIDED DRAFTING AND MODELING LABORATORY	0	0	3	1.5	100

Objective(s)	To impart knowledge on • To develop skill to use software to create 2D and 3Dmodels.
Outcome(s)	Upon Completion of the course, the students will be able to: • Ability to use the software packers for drafting and modeling. • Ability to create 2D and 3D models of Engineering Components.

LIST OF EXPERIMENTS

1.	Study of capabilities of software for Drafting and Modeling – Coordinate systems (absolute, relative, polar)–Creation of simple figures like polygon and general multi-line figures.
2.	Drawing of a Title Block with necessary text and projection symbol.
3.	Drawing of curves like ellipse, parabola, hyperbola, cycloid, involutes.
4.	Drawing of front view and top view of simple solids like prism, pyramid, cylinder and cone - dimensioning.
5.	Drawing front view, top view and side view of objects from the given pictorial views (eg. V-block, Simple stool, Objects with hole and curves).
6.	Drawing of a plan of residential building (Two bed rooms, kitchen, hall, etc.).
7.	Drawing of a simple steel truss.
8.	Drawing sectional views of prism, pyramid, cylinder and cone.
9.	Drawing isometric projection of simple objects.
10.	Creation of 3-D models of simple objects and obtaining 2-D multi-view drawings from 3-D model.
	Total hours to be taught **45 Periods**

LIST OF EQUIPMENTS (for a batch of 30 students)

1.	Better hardware, with suitable graphics facility -30 Nos.
2.	Licensed software for Drafting and Modeling. - 30Licenses
3.	Laser Printer or Plotter to print /plot drawings - 1No

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III SEMESTER

Regulation 2022							
III Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MA12303	Partial Differential Equations & Numerical Methods	BS	3	1	0	4
2	22MT14301	Strength of Materials for Mechatronics	PC	3	1	0	4
3	22MT14302	Basics of Fluid Mechanics and Machinery	PC	3	0	0	3
4	22MT14303	Electrical Drives and Actuators	PC	3	0	0	3
5		Open Elective - 1	OE	3	0	0	3
6	22SH11006	Universal Human Values	HS	3	0	0	3
PRACTICAL							
7	22MT24301	Strength of Materials Laboratory	PC	0	0	3	1.5
8	22MT24302	Fluid Mechanics and Machinery Laboratory	PC	0	0	3	1.5
9	22MT24303	Electrical Drives and Machines Laboratory	PC	0	0	3	1.5
		TOTAL		**18**	**2**	**9**	**24.5**

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code & Name			1101 & MCT	
III Semester						
Course code	**Course Name**	**Hours/week**			**Credit**	**Maximum marks**
		L	**T**	**P**	**C**	
22MA12303	**PARTIAL DIFFERENTIAL EQUATIONS & NUMERICAL METHODS**	3	1	0	4	**100**

Objective(s)

To enable the students to:

- Learn about the techniques to solve partial differential equations.
- Study the method of separation of variables and solving boundary value problems using Fourier series.
- Acquire the knowledge of the solution of algebraic and transcendental equations and study the methods to solve linear system of equations by direct and iterative methods.
- Evaluate the derivatives from finite differences and evaluate single and double integrals by numerical integration methods.
- Gain the knowledge to solve ordinary differential equations by single step and multi - step methods.

Outcome(s)

At the end of the course, the students will be able to:

- Formulate partial differential equations by eliminating arbitraryconstants and functions.
- Classify the types of PDE of second and higher order with constant coefficients
- Determine the solution of algebraic and transcendental equations and system of linear equations numerically.
- Acquire the knowledge of numerical differentiation and integration using finite differences.
- Solve ordinary differential equations using numerical methods.

UNIT - I	**PARTIAL DIFFERENTIAL EQUATIONS**	**(9+3)**

Formation of partial differential equations by eliminating arbitrary constants and by eliminating arbitrary functions-Formation of Lagrange's linear equation-Homogeneous linear partial differential equations of second and higher order with constant coefficients.

UNIT - II	**APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATIONS**	**(9+3)**

Solutions of one dimensional wave equation – One dimensional equation of heat conduction – Steady state solution of two-dimensional equation of heat conduction (Insulated edges excluded) – Fourier series solutions in cartesian coordinates.

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

UNIT - III	NUMERICAL SCHEEMS OF SOLVING EQUATIONS	(9+3)
Solution of equation – Iteration method and Newton - Raphson method – Solution of linear system by Gaussian elimination and Gauss-Jordon method– Iterative method –Gauss Jacobi method and Gauss-Seidel method – matrix inversion by Gauss Jordon method.		

UNIT - IV	NUMERICAL DIFFERENTIATION AND INTEGRATION	(9+3)
Differentiation using Newton's forward and backward interpolation formula –Numerical integration by Trapezoidal and Simpson's 1/3 and 3/8 rules – Two and Three point Gaussian quadrature formulae – Double integrals using Trapezoidal and Simpsons's rules.		
UNIT - V	**INITIAL VALUE PROBLEMS FOR ORDINARY DIFFERENTIAL EQUATIONS**	**(9+3)**
Single step methods: Taylor series method – Euler's method and Modified Euler method for first order equation – Fourth order Runge – Kutta method for solving first order equations – Multistep method: Milne's predictor and corrector methods.		
	Total hours to be taught	**(L:45+T:15): 60 Periods**

TEXT BOOKS :

1	Veerarajan.T, " Transforms and Partial Differential Equations" , First Edition, Tata McGrawHill, 2018.
2.	Dr.P.Kandasamy, Dr.K.Thilagavathy and Dr.K.Gunavathy, " Engineering Mathematics Volume – III",S.Chand & company Ltd. New Delhi, Revised Edition 2012.

REFERENCE:

1	N.P. Bali and Manish Goyal, , Transforms and Partial Differential Equations Laxmi Publications, 2010
2	Erwin kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, 2016.
3	Sankara Rao K, "Numerical Methods for Scientisits and Engineering", 3rd Edition, Printice Hall of India Private Ltd, New Delhi, 2007.
4	Gerald, C.F.and Wheatley, P.O., " Applied Numerical Analysis", 6th Edition, Pearson Education, Asia,New Delhi, 2006.

Dr. T.JESUDAS, M.E., Ph.D
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Department	Mechatronics	Programme Code	1101

III Semester

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT14301	STRENGTH OF MATERIALS FOR MECHATRONICS	3	1	0	4	100

Objective(s)	• To understand the concepts of stress, strain, principal stresses and principal planes • To study the concept of shearing force and bending moment due to external loads in determinate beams and their effect on stresses. • To determine stresses and deformation in circular shafts and helical spring due to torsion. • To compute slopes and deflections in determinate beams by various methods. • To study the stresses and deformations induced in thin and thick shells.
Outcome(s)	At the end of the course the students would be able to 1. Apply the concepts of stress and strain in simple and compound bars, and explain the importance of principal stresses and principal planes. 2. Identify the load transferring mechanism in beams and calculate the stress distribution due to shearing force and bending moment. 3. Apply basic equation of torsion in designing of shafts and helical springs 4. Calculate slope and deflection in beams using different methods. 5. Analyze thin and thick shells for applied pressures.

UNIT-I	**STRESS STRAIN DEFORMATION OF SOLIDS**	**(9+3)**

Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear –Deformation of simple and compound bars under axial load –Thermal stress – Elastic constants –Volumetric strains – Stresses on inclined planes – Principal stresses and principal planes – Mohr's circle of stress.

UNIT-II	**TRANSVERSE LOADING ON BEAMS AND STRESSES IN BEAM**	**(9+3)**

Beams – Types - Transverse loading on beams – Shear force and Bending moment in beams – Cantilever, Simply supported and over hanging beams. Theory of simple bending – Bending stress distribution – Load carrying capacity – Proportioning of sections – Flitched beams– Shear stress distribution.

UNIT-III	**TORSION**	**(9+3)**

Analysis of torsion of circular bars – Shear stress distribution – Bars of Solid and hollow circular section – Stepped shaft – Twist and torsion stiffness – Compound shafts – Fixed and simply supported shafts– Application to close- coiled helical springs–Maximum shear stress in spring section including Wahl Factor – Deflection of helical coil springs under axial loads – Design of helical coil springs – stresses in helical coil springs under torsion loads.

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

UNIT-IV	**BEAM DEFLECTION**	**(9+3)**
Elastic curve – Governing differential equation - Double integration method - Macaulay's method - Area moment method - Conjugate beam method for computation of slope and deflection of determinant beams.		
UNIT-V	**THIN CYLINDERS, SPHERES AND THICK CYLINDERS**	**(9+3)**
Stresses in thin cylindrical shell due to internal pressure - circumferential and longitudinal stresses - Deformation in thin cylinders – Spherical shells subjected to internal pressure – Deformation in spherical shells – Thick cylinders - Lame's theory.		
	Total hours to be taught	**60 Periods**

TEXT BOOKS :

1	Popov E.P, "Engineering Mechanics of Solids", Prentice-Hall of India, New Delhi, 1997.
2	Beer F. P. and Johnston R," Mechanics of Materials", McGraw-Hill Book Co, Third Edition, 2002.

REFERENCE:

1	Nash W.A, "Theory and problems in Strength of Materials", Schaum Outline Series, McGraw-Hill Book Co, New York, 1995.
2	Kazimi S.M.A, "Solid Mechanics", Tata McGraw-Hill Publishing Co., New Delhi, 1981.
3	Ryder G.H, "Strength of Materials, Macmillan India Ltd"., Third Edition, 2002.
4	Ray Hulse, Keith Sherwin & Jack Cain, "Solid Mechanics", Palgrave ANE Books, 2004.
5	Singh D.K "Mechanics of Solids" Pearson Education 2002.

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Department	Mechatronics	Programme Code	1101

III Semester

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT14302	BASICS OF FLUID MECHANICS AND MACHINERY	3	0	0	3	100

Objective(s)	• To impart knowledge on the properties of fluid and fluid statics principles • To calculate the rate of flow and energy losses in flow through pipes • To emphasize the concepts of boundary layer theory and the importance of dimensional analysis • To educate the working principles and performance analysis of fluid pumps. • To provide knowledge on the working principle and performance curves of hydraulic turbines
Outcome(s)	At the end of the course, the students will be able to 1. Explain the fluid properties and the pressure measurement using fundamental laws of fluid mechanics 2. Analyze the volume rate of flow and losses occur in a flow through pipes. 3. Apply the concept of boundary layer, Dimensional analysis and Modal analysis on the fluid structures 4. Select a suitable pump for a given application and evaluate the operating characteristics of Hydraulic pumps 5. Choose a suitable turbine for a given application and evaluate the operating characteristics of Hydraulic turbines

UNIT-I	**FLUID PROPERTIES AND FLOW CHARACTERISTICS**	**(9)**

Fluid – definition, distinction between solid and fluid – Units and dimensions – Properties of fluids – Fluid statics - Pressure Measurements - Buoyancy and floatation. Flow characteristics – concept of control volume – application of continuity equation, energy equation and momentum equation.

UNIT-II	**FLOW THROUGH PIPES**	**(9)**

Reynold's Experiment - Laminar flow through circular conduits - Darcy Weisbach equation - friction factor - Moody diagram - Major and minor losses -Hydraulic and energy gradient lines - Pipes in series and parallel.

UNIT-III	**FLUID FLOW OVER BODIES AND DIMENSIONAL ANALYSIS**	**(9)**

Boundary layer concepts-Types of boundary layer thickness -Lift and Drag of an aerofoil-Need for dimensional analysis -Methods of dimensional analysis using Buckingham pi theorem -Similitude - Types of similitude-Dimensionless parameters-Application of Dimensionless parameters

UNIT-IV	**TURBINES**	**(9)**

Classification of turbines heads and efficiencies velocity triangles. Axial, radial and mixed flow turbines. Pelton wheel, Francis turbine and Kaplan turbines- working principles.Work done by water on the runner draft tube. Specific speed unit quantities performance curves for turbines.

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UNIT-V	PUMPS	(9)
Euler's equation - Theory of roto-dynamic machines-Centrifugal pumps working principle- velocity triangle -work done by the impeller - performance curves - Reciprocating pump- working principle Rotary pumps –classification		
	Total hours to be taught	**45 Periods**

TEXT BOOKS :	
1	Bansal, R.K., Fluid Mechanics and Hydraulics Machines, Laxmi Publications (P) Ltd., New Delhi.
2	Streeter. V. L., and Wylie, E.B., Fluid Mechanics, McGraw Hill, 1983.
REFERENCE:	
1	Kumar. K.L., Engineering Fluid Mechanics (VII Ed.) Eurasia Publishing House (P) Ltd., New Delhi, 1995.
2	Ramamritham. S, Fluid Mechanics, Hydraulics and Fluid Machines, Dhanpat Rai & Sons, Delhi, 1988.
3	Rathakrishnan. E, Fluid Mechanics, Prentice Hall of India (II Ed.), 2007.
4	White, F.M., Fluid Mechanics, Tata McGraw-Hill, New Delhi, 2003.
5	Som, S.K., and Biswas, G., Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw-Hill, 2004.

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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code	1101

III Semester

Course code	Course Name	Hours/week		Credit		Maximum marks
		L	T	P	C	
22MT14303	ELECTRICAL DRIVES AND ACTUATORS	3	0	0	3	100

Objective(s)	• To familiarize a relay and power semiconductor devices. • To get a knowledge on drive characteristics. • To obtain the knowledge on DC motors and drives. • To obtain the knowledge on AC motors and drives. • To obtain the knowledge on Stepper and Servo motor.
Outcomes	At the end of the course, the student able to: ▪ **Recognize** the principles and working of relays, drives and motors. ▪ **Explain** the working and characteristics of various drives and motors. ▪ **Apply** the solid state switching circuits to operate various types of Motors and Drivers ▪ **Interpret** the performance of Motors and Drives. ▪ **Illustrate** the Motors and Drivers for given applications

UNIT-I	**RELAY AND POWER SEMI-CONDUCTOR DEVICES**	**(9)**
Study of Switching Devices – Relay and Types, Switching characteristics -BJT, SCR, TRIAC, GTO, MOSFET, IGBT and IGCT-: SCR, MOSFET and IGBT - Triggering and commutation circuit - Introduction to Driver and snubber circuits.		
UNIT-II	**DRIVE CHARACTERISTICS**	**(9)**
Electric drive – Equations governing motor load dynamics – steady state stability – multi quadrant Dynamics: acceleration, deceleration, torque, and Direction starting & stopping – Selection of motor.		
UNIT-III	**DC MOTORS AND DRIVES**	**(8)**
DC Servomotor - Types of PMDC & BLDC motors - principle of operation- emf and torque equations - characteristics and control – Drives- H bridge - Single and Three Phases – 4 quadrant operation – Applications.		
UNIT-IV	**AC MOTORS AND DRIVES**	**(9)**
Introduction – Induction motor drives – Speed control of 3-phase induction motor – Stator voltage control – Stator frequency control – Stator voltage and frequency control – Stator current control – Static rotor resistance control – Slip power recovery control.		
UNIT-V	**STEPPER AND SERVO MOTOR**	**(10)**
Stepper Motor: Classifications- Construction and Principle of Operation – Modes of Excitation Drive System-Logic Sequencer - Applications. Servo Mechanism – DC Servo motor-AC Servo motor – Applications.		

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Mallasamudram, Namakkal

Total hours to be taught	**45 Periods**

TEXT BOOKS	
1	Bimbhra B.S., "Power Electronics", 5th Edition, Kanna Publishers, New Delhi, 2012.
2	Mehta V.K. & Rohit Mehta, "Principles of Electrical Machines", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2016.
REFERENCE	
1	Gobal K. Dubey, "Fundamentals of Electrical Drives", 2nd Edition, Narosal Publishing House, New Delhi, 2001.
2	Theraja B.L. &Theraja A.K., "A Text Book of Electrical Technology", 2nd Edition, S.Chand& Co. Ltd., New Delhi, 2012.
3	Singh M.D. &Kanchandhani K.B., "Power Electronics", McGraw Hill, New Delhi, 2007

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Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22SH11006	UNIVERSAL HUMAN VALUES	2	1	0	3	100

(Mandatory Credit Course to All UG Programmes to be offered in III / IV Semester)
Pre-requisites: Universal Human Values 1 (Induction Programme) (desirable)

The foundation course "H-102 Universal Human Values: "Understanding Harmony" may be covered in III or IV semester. This course discusses the role of human beings in their family. It also touches issues related to their role in the society and the nature. During the Induction Program, students would get an initial exposure to human values through Universal Human Values 1. This exposure is to be augmented by this compulsory full semester foundation course. The Course has 5 Modules (5 Units): 30 Lectures and 15 Practice sessions (Tutorials).

1. COURSE OBJECTIVES:

The objectives of the course are:
(i). Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
(ii). Understanding (or developing clarity) the harmony in the human being, family, society and nature/existence
(iii). Strengthening of self-reflection for harmonious relationship in family, society
(iv). Development of commitment and courage to act as human being in ensuring harmony in nature for co-existence.
(v). Development of holistic principles of harmony and professional ethics for natural acceptance of human values and observe ethical human conduct.

2. COURSE OUTCOMES:

Upon completion of the Course the Learner will be able to:
- Distinguish between values and skills, and highlight the need for Universal Human Values.
- Describe the need for Harmony and distinguish between happiness and accumulation of physical facilities, etc.
- Relate the value of harmonious relationship in family, society based on trust and respect for happiness and prosperity in their life and profession.
- Outline the role of a human being in ensuring harmony in nature for co-existence.
- Apply the holistic principles of Harmony and Professional Ethics for natural acceptance of human values and observe Ethical Human Conduct.

Module 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education
L 1. Purpose and motivation for the course, recapitulation from Universal Human Values-I (Induction Programme).
L 2. Self-Exploration–what is it? Its content and process; 'Natural Acceptance' and Experiential Validation-as the process for self-exploration.
L 3. Continuous Happiness and Prosperity - A look at basic Human Aspirations.
L 4. Right understanding, Relationship and Physical Facility - the basic requirements for fulfillment of aspirations of every human being with their correct priority.
L 5. Understanding Happiness and Prosperity correctly - A critical appraisal of the current scenario.
L 6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

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Mallasamudram, Namakkal

3 Practice sessions *(T1 to T3) - To discuss natural acceptance in human being as the innate acceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.*

Module 2: Understanding Harmony in the Human Being - Harmony in Myself!

L 7. Understanding human being as a co-existence of the sentient 'I' and the material 'Body'
L 8. Understanding the needs of Self ('I') and 'Body'- happiness and physical facility
L 9. Understanding the Body as an instrument of 'I'(I being the doer, seer and enjoyer)
L 10.Understanding the characteristics and activities of 'I' and harmony in 'I'
L 11.Understanding the harmony of I with the Body: Sanyam and Health; correct appraisal of Physical needs, meaning of Prosperity in detail.
L 12.Programs to ensure Sanyam and Health.

3 Practice sessions *(T4 to T6) - To discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease.*

Module 3: Understanding Harmony in the Family and Society - Harmony in Human-Human Relationship

L 13. Understanding values in human-human relationship; meaning of Justice (Nine universal values in relationships) and program for its fulfillment to ensure mutual happiness; Trust and Respect as the foundational values of relationship.
L 14. Understanding the meaning of Trust; Difference between intention and competence.
L 15. Understanding the meaning of Respect, Difference between respect and differentiation; the other salient values in relationship.
L 16. Understanding the harmony in the society (society being an extension of family): Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals.
L 17. Visualizing a universal harmonious order in Society-Undivided Society, Universal Order-from family to world family.

3 Practice sessions *(T7 to T9): Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education, etc. Discuss Gratitude as a universal value in relationships, scenarios. Elicit examples from students' lives.*

Module4: Understanding Harmony in the Nature and Existence - Whole existence as Coexistence

L 18. Understanding the harmony in the Nature.
L 19. Interconnectedness and mutual fulfillment among the four orders of nature - recyclability and self-regulation in nature.
L 20. Understanding Existence as Co-existence of mutually interacting units in all - pervasive space.
L 21. Holistic perception of harmony at all levels of existence.
2 Practice sessions *(T10 to T11): Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology, etc.*

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Module 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

L 22. Natural acceptance of human values.
L 23. Definitiveness of Ethical Human Conduct.
L 24. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order.
L 25. Competence in professional ethics: (a). Ability to utilize the professional competence for augmenting universal human order (b). Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems, (c). Ability to identify and develop appropriate technologies and management patterns for above production systems.
L 26. Case studies of typical holistic technologies, management models and production systems.
L 27. Strategy for transition from the present state to Universal Human Order: (a). At the level of individual: as socially and ecologically responsible engineers, technologists and managers (b). At the level of society: as mutually enriching institutions and organizations.
L 28. Definition of Morals, Values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully.
L 29. Importance of Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self-confidence – Character – Spirituality.
L 30. Introduction to Yoga and meditation for professional excellence and stress management.
Sum up.
4 Practice sessions *(T12 to T15) - Include Practice Exercises and Case Studies which will be taken up in Practice (Tutorial) Sessions.*
eg. To discuss the conduct as an Engineer or Scientist, etc.
TOTAL = 45 Hours

3. READINGS:

3.1 Textbook

1. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

3.2 Reference Books

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amarkantak, 1999.
2. Human Values, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of My Experiments with Truth -by Mohandas Karamchand Gandhi
4. Small is Beautiful - E. F Schumacher.
5. Slow is Beautiful - Cecile Andrews.
6. Economy of Permanence - J C Kumarappa.
7. Bharat Mein Angreji Raj - Pandit Sunderlal.
8. Rediscovering India by Dharampal.
9. Hind Swaraj or Indian Home Rule - by Mohandas K. Gandhi.
10. India Wins Freedom - Maulana Abdul Kalam Azad.
11. Vivekananda - Romain Rolland (English).
12. Mika Martin and Roland Scinger, 'Ethics in Engineering', Pearson Education/Prentice Hall, New York 1996.

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Department	Mechatronics	Programme Code	1101

III Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT24301	STRENGTH OF MATERIALS LABORATORY	0	0	3	1.5	100

Objective(s)	• To study the mechanical properties of materials when subjected to tension. • To study the mechanical properties of materials when subjected to torsion. • To study the mechanical properties of hardness materials. • To study the mechanical properties of materials when subjected to compression load. • To study the mechanical properties of materials when the materials gets deformed.
Outcome(s)	The students will be 1. Ability to perform Tension test. 2. Ability to perform Torsion test. 3. Ability to perform Hardness test. 4. Ability to perform Compression test. 5. Ability to perform Deformation test on Solid materials.

LIST OF EXPERIMENTS

1.	Tension test on a mild steel rod
2.	Double shear test on Mild steel and Aluminum rods
3.	Torsion test on mild steel rod
4.	Impact test on metal specimen
5.	Hardness test on metals - Brinnell and Rockwell Hardness Number
6.	Hardness test on wood - universal testing machine
7.	Deflection test on cantilever beams
8.	Deflection test on wooden beams
9.	Compression test on helical springs
	Total hours to be taught **30 Periods**

Dr. T.JESUDAS, M.E., Ph.D
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Department	Mechatronics	Programme Code	1101

III Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT24302	FLUID MECHANICS AND MACHINERY LABORATORY	0	0	3	1.5	100

Objective(s)

- To verify the principles studied in Fluid Mechanics theory by performing experiments in lab.
- To study and understand the importance of various types of flow in pumps.
- To study and understand the importance of dimensional analysis.
- To study and analyze the performance of pumps.
- To study and analyze the performance of turbines.

Outcome(s)

The students should be able to

1. Use the measurement equipments for flow measurement.
2. Perform test on flow measurement devices.
3. Can analyze and calculate major and minor losses associated with pipe flow in piping.
4. Perform test on different types of fluid pumps.
5. Perform test on different types of fluid turbines.

LIST OF EXPERIMENTS

1.	Determination of the Coefficient of discharge of given Orifice meter.
2.	Determination of the Coefficient of discharge of given Venturi meter.
3.	Determination of minor losses in pipes.
4.	Determination of friction factor for a given set of pipes.
5.	Bernoulli's Theorem – Verification
6.	Conducting experiments and drawing the characteristic curves of centrifugal pump.
7.	Conducting experiments and drawing the characteristic curves of reciprocating pump.
8.	Conducting experiments and drawing the characteristic curves of Gear pump.
9.	Conducting experiments and drawing the characteristic curves of Pelton wheel.
10.	Conducting experiments and drawing the characteristics curves of Francis turbine.
	Total hours to be taught **30 Periods**

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Department	Mechatronics	Programme Code	1101

III Semester

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22MT24303	ELECTRICAL MACHINES & DRIVES LABORATORY	0	0	3	1.5	100

Objective(s)	• To impart knowledge on Performance of the fundamental control practices associated with AC and DC machines (starting, reversing, braking, plugging, etc.) using power electronics. • To impart industry oriented learning. • To evaluate the use of computer-based analysis tools to review the major classes of machines and their physical basis for operation.
Outcome(s)	1. **Illustrate** the basic working of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive. 2. **Demonstrate** the control of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive. 3. **Analyze** the performance of AC, DC motor, stepper motor, servo motor and synchronous motor using power electronic drive.

LIST OF EXPERIMENTS

1.	Load test on DC Motor.
2.	Load test on 3 Phase Induction Motor.
3.	Load test on 3 Phase Synchronous Motor.
4.	Rheostat based Speed control of motors (AC and DC).
5.	Switching circuits of MOSFET, IGBT, SCR and TRAIC.
6.	Gate pulsation generation using PWM signals.
7.	Speed control of DC motor using Power Electronic Drive.
8.	Position and direction control DC servomotor using Power Electronic Drive.
9.	Position, direction and speed control of BLDC and PMDC motors using Power Electronic Drive.
10.	Position, Direction and speed control of stepper Motor.
11.	AC servomotor position, direction and speed control using Power Electronic Drive.

Total hours to be taught **30 Periods**

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IV SEMESTER

Regulation 2022							
IV Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MT14401	Kinematics and Dynamics of Machinery	PC	3	1	0	4
2	22MT14402	Manufacturing Technology	PC	3	0	0	3
3	22MT14403	Digital Principles and System Design	PC	3	0	0	3
4	22MT15008	Professional Elective – 1(Product Design and Development)	PE	3	0	0	3
5	22AE15405	Open Elective – 2 (Basics of Mechanical Design)	OE	3	0	0	3
6	22MA12401	Open Elective – 3 (Numerical, Logical and Visual Reasoning Skills)	OE	3	0	0	3
7	22CY11001	Environmental Science	BS	3	-	-	-
PRACTICAL							
8	22MT24401	Dynamics Laboratory	PC	0	0	3	1.5
9	22MT24402	Manufacturing Technology Laboratory	PC	0	0	3	1.5
10	22EN60001	Professional Communication Skills	EEC	0	1	1	2
TOTAL				**21**	**2**	**7**	**24**

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Department	Mechatronics Engineering			Programme Code	1101	
IV Semester						
Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT14401	KINEMATICS AND DYNAMICS	3	1	0	4	100

Objective(s)	• To introduce the fundamental concepts of mechanisms and kinematics. • To study the basic concepts of toothed gearing and kinematics of gear trains • To Analyzing the force-motion relationship in components subjected to external forces and analyzing of standard mechanisms • To Analyzing the undesirable effects of unbalances resulting from prescribed motions in mechanism and the effect of dynamics of undesirable vibrations. • To introduce the mechanisms for control, focusing on governors and gyroscopic forces.
Outcome(s)	The students will be able to 1. **Discuss** the basics of mechanism. 2. **Solve** problems on gears and gear trains. 3. **Calculate** static and dynamic forces of mechanisms. 4. **Calculate** the balancing masses and their locations of reciprocating and rotating masses. **Computing** the frequency of free vibration, forced vibration and damping coefficient. 5. **Describe** and **analyze** governors and gyroscopic effects and evaluate the impact of gyroscopic forces on automobiles, ships, and airplanes.

UNIT-I	BASICS OF MECHANISMS	(9+3)

Basic concepts of Link, Kinematic pair, Kinematic chain, Mechanism, Machine, Degree of Freedom, Kutzbach and Gruebler's criterion and Grashoff's law - Kinematic Inversions of four bar chain and slider crank chain - Mechanical Advantage - Transmission angle. kinematics analysis in simple mechanisms – velocity and acceleration of single slider crank mechanism.

UNIT-II	GEARS AND GEAR TRAINS	(9+3)

Spur gear – law of toothed gearing – involute gearing – Interchangeable gears – Gear tooth action interference and undercutting – nonstandard teeth – gear trains – parallel axis gears trains – epicyclic gear trains – automotive transmission gear trains.

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UNIT-III	DYNAMIC FORCE ANALYSIS OF MECHANISMS	(9+3)
Applied and Constrained Forces – Free body diagrams – static Equilibrium conditions – Two, Three and four members – Static Force analysis in simple machine members – Dynamic Force Analysis – Inertia Forces and Inertia Torque – D'Alembert's principle – superposition principle – dynamic Force Analysis in simple machine members		
UNIT-IV	**BALANCING AND VIBRATION**	**(9+3)**
Static and Dynamic balancing – Balancing of revolving and reciprocating masses – Balancing machines – free vibrations – Equations of motion – natural Frequency – Damped Vibration – bending critical speed of simple shaft – Torsional vibration – Forced vibration – harmonic Forcing – Vibration isolation.		
UNIT-V	**MECHANISM FOR CONTROL**	**(9+3)**
Governors – Types – Centrifugal governors – Gravity controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes – Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.		
	Total hours to be taught	**60 Periods**

TEXT BOOK :

1	Uicker, J.J., Pennock G.R and Shigley, J.E., "Theory of Machines and Mechanisms", Oxford University Press, 2017.
2	Rattan SS, "Theory of Machines", 5th Edition, Tata McGraw-Hill, 2019.

REFERENCE:

1	Thomas Bevan, "Theory of Machines", 3rd Edition, CBS Publishers and Distributors, 2010.
2	Cleghorn. W. L, "Mechanisms of Machines", Oxford University Press, 2014.
3	Benson H. Tongue, "Principles of Vibrations", Oxford University Press, 2nd Edition, 2012.
4	Robert L. Norton, "Kinematics and Dynamics of Machinery", Tata McGraw-Hill, 2017.
5	Wilson and Sadler, Kinematics and Dynamics of Machinery, Pearson, 2008.
6	Khurmi RS, Gupta JK "Theory of Machines", S Chand Publications, 2020.

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Department	Mechatronics Engineering	Programme Code	1101

IV Semester

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT14402	MANUFACTURING TECHNOLOGY	3	0	0	3	100

Objective(s)	• To help acquire knowledge about the behavior and manufacturing properties of all engineering materials and basic concepts of foundry and casting processes. • To teach various methods of welding processes. • To understand advanced metal forming processes in detail. • To learn the concepts on basic conventional machines. • To impart knowledge on Non-conventional machining processes.
Outcome(s)	The students will be able to 1. Explain different metal casting processes, associated defects, merits and demerits. 2. Compare different metal joining processes. 3. Explain the theories of advanced metal forming. 4. Explain various primary machining processes 5. Appraise the abrasive machining process based on the surface finish requirements.

UNIT-I	**CASTING PROCESSES**	**(9)**

Introduction to casting, Patterns, Types, Pattern Materials, allowances - Moulding - types- Moulding sand, Requirements of moulding sands, Riser Cores & Core making. Special Casting Process, Die casting, Centrifugal Casting. Casting Defects. Melting furnaces Cupola and Induction furnaces.

UNIT-II	**METAL JOINING PROCESSES**	**(9)**

Classifications - Welding equipment's, power requirement - Electrode Types - Specification, Gas welding - Types, Arc welding, TIG, MIG, Atomic Hydrogen, Co2 welding, Submerged Arc welding. Special welding-Laser, Electron Beam, Plasma Arc, Ultrasonic, Friction welding, Welding Defects - welding inspection and testing, Soldering, Brazing.

UNIT-III	**ADVANCED FORMING PROCESSES**	**(9)**

Introduction to forming process. Elastic & plastic deformation, yield criteria. Hot working and cold working of metals. Electro-magnetic forming, Explosive forming, Electro-hydraulic forming, Stretch forming, Contour roll forming.

Dr. T.JESUDAS, M.E., Ph.D
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UNIT-IV	MATERIAL REMOVAL PROCESS	(9)
Lathes-Introduction, Specification, types, Mechanism and attachments for various operations, Work and tool holding devices. Drilling machine-Specification-Types-Accessories- Feed mechanism-operations. Twist drill nomenclature. Generation of plain surfaces – shaping, planning, broaching: types, operations and mechanism.		
UNIT-V	**NON-CONVENTIONAL MACHINING PROCESSES**	**(9)**
Need for Unconventional processes – Electrical discharge machining (EDM) – Dielectric fluid – electrode – wire EDM –Electrochemical Machining (ECM) –Electrochemical Grinding (ECG), Ultrasonic Machining (USM) – Abrasive Jet Machining (AJM) – Laser Beam Machining (LBM) – Plasma Arc Machining (PAM).		
	Total hours to be taught	**45 Periods**

TEXT BOOKS:

1	Hajra Choudhury, S.K., and Haqjra Choudhury, A.K., "Elements of Workshop Technology", Volume I and II, Media Promoters and Publishers Private Limited, Mumbai.
2	Sharma P.C. A Textbook of Production Technology, S. Chand and Co., Ltd.

REFERENCE:

1	Kalpakjian, s., "Manufacturing Engineering and Technology", Pearson education India, 4 edition, 2001 (ISBN 81 78081 571).
2	Paul Degarma E, Black J.T. and Ronald A. Kosher, "Materials and Processes in Manufacturing" Eighth edition, Prentice – Hall of India, 1997.

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Department	Mechatronics Engineering	Programme Code			1101	
IV Semester						
Course code	Course Name	Hours/week			Credit	Maximum marks
22MT14403	DIGITAL PRINCIPLES AND SYSTEM DESIGN	L	T	P	C	100
		3	0	0	3	

Objective(s)	• To learn about the basics of digital logic circuits using logic gates. • To impart knowledge on solving combinational circuits using logic gates. • To impart knowledge on solving sequential circuits using flip flops. • To understand the working principle of various memory devices and programmable logic devices. • To design and construct combinational and sequential circuits.
Outcome(s)	On the successful completion of the course, students will be able to • Explain the concept of Boolean algebra and logic gates. • Build the combinational circuits using logic gates. • Contrast and debug the sequential circuit elements and its conversions. • Interpret the types of memories with their operations and programmable logic devices. • Develop the synchronous and Asynchronous sequential circuits using flip flops.

UNIT-I	DIGITAL FUNDAMENTALS	(9)

Number Systems — Decimal, Binary, Octal, Hexadecimal, 1's and 2's complements, Codes — Binary, BCD, Excess 3, Gray, Boolean theorems, Logic gates, Universal gates, Sum of products and product of sums, Minterms and Maxterms, Karnaugh map Minimization and Quine-McCluskey method of minimization.

UNIT-II	COMBINATIONAL CIRCUIT DESIGN	(9)

Design of Half and Full Adders, Half and Full Subtractors, Binary Parallel Adder — Carry look ahead Adder, BCD Adder, Multiplexer, Demultiplexer, Magnitude Comparator, Decoder, Encoder, Priority Encoder.

UNIT-III	SEQUENTIAL CIRCUITS DESIGN	(9)

Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation Application table – Edge triggering – Level Triggering –Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Design of Synchronous counters: Modulo–n counter, Registers –Shift register counters.

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UNIT-IV	**MEMORY DEVICES**	**(9)**
Classification of memories – ROM AND RAM -Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) -Implementation of combinational logic circuits using ROM, PLA, PAL.		
UNIT-V	**SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS**	**(9)**
Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits. **Asynchronous Sequential Circuits:** Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits.		
Total hours to be taught		**45 Periods**

TEXT BOOK:	
1	M. Morris Mano, "Digital Design", 4th Edition, Prentice Hall of India Pvt. Ltd., 2008 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
REFERENCE:	
1	John F.Wakerly, "Digital Design", Fourth Edition, Pearson/PHI, 2008.
2	John.M Yarbrough, "Digital Logic Applications and Design", Thomson Learning, 2006.
3	Charles H.Roth. "Fundamentals of Logic Design", 6th Edition, Thomson Learning, 2013.
4	Donald P.Leach and Albert Paul Malvino, "Digital Principles and Applications", 6th Edition, TMH, 2006.
5	Donald D.Givone, "Digital Principles and Design", TMH, 2003.
6	Thomas L. Floyd, "Digital Fundamentals", 10th Edition, Pearson Education Inc, 2011.

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COURSE CODE	COURSE NAME	HOURS/WEEK			CREDIT	MAXIMUM MARKS
		L	T	P	C	
22AE15405	BASICS OF MECHANICAL DESIGN	3	0	0	3	100
Objective	➢ To the basics of Design for Mechanical components, sheet metal piping and Valves					
Outcome(s)	After completing the course the students: ➢ To Analysis the Engineering Drawing from various views. ➢ To apply the GD &T in Engineering Drawings ➢ To Familiarize the basics process of Automotive Industry ➢ Gain knowledge about pipe and valves design ➢ Have the necessary understanding on Properties of materials and their uses					
UNIT I	ENGINEERING GRAPHICS FOR DESIGN & ANALYSIS					(6)
Graphical Representation-Projection Basics, First angle, Third angle - Orthographics Projections - Auxilary and Sectional Projections -Isometric Projections- Practice the Drawings.						
UNIT II	GEOMETRIC DIMENSIONING AND TOLERANCING					(12)
GD&T-Basic Terminology- GD&T Framework-Size Tolerances- Datums- Position- Orientation (Axis / Midplane)- Material Modifiers- Surface Profile-Surface Orientation-Surface Form-Runout Controls-Derived Element Controls.						
UNIT-III	AUTOMOTIVE INDUSTRY-PLASTIC AND SHEET METAL					(9)
Product Life Cycle-Design Life Cycle-Types of plastics (Thermoset Plastics, Thermoplastic)-Engineering plastic Materials-Manufacturing Process-Injection Molding- Automotive Sheet Metal materials-Design Flexibility-Precision and Accuracy-Types Of Sheet Metals-Sheet Metal Fabrication Techniques-Sheet Metal Cutting Techniques-Sheet Metal Forming Techniques-Challenges-Applications Of Sheet Metal Fabrication Parts In The Automotive Industry- -Introduction to Vehicle Electrical Distribution System (EDS) - wiring harness assembly- (NPD)- DIW Systems- BIW fixture design.						
UNIT-IV	PIPE AND VALVES DESIGN					(9)
Piping And About Oil And Gas-Pipe Fitting-Flange Basics-Valve Basics-Pipe Drafting- Codes & Standards-Piping Fabrication-Introduction To Frp Pipes-Piping Sometrics, Symbole, Codes, Drawings.						
UNIT-V	ENGINEERING MATERIALS					(9)
Engineering materials classification-Metals, Polymeric Materials, Ceramic materials, Composite Materials, Electronic Materials, Smart Materials-Mechanical Properties of Materials-Elastic and Plastic deformation Graphical representation-Hardness-Stifness-toughness-wear-Fatique-Creep-Iron-carbon phase diagram-Tool and die steels.						
	Total hours to be taught					45 Periods

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TEXT BOOKS :	
1.	Kaushik Kumar/ Roy, Apurba Kumar & Ranjan, Chikesh "Engineering Graphics & Design" 2001.
2.	Georg Henzold "Geometrical Dimensioning and Tolerancing for Design" 2006.
3.	Joseph P. Greene "Automotive Plastics and Composites: Materials and Processing" 2021.
4.	Karan Sotoodeh "A Practical Guide to Piping and Valves for the Oil and Gas" 2021.
REFERENCE:	
1.	A. M. Chandra, Satish Chandra Engineering Graphics 2003.
2.	Callister, William D., "Materials Science and Engineering: An Introduction," 9th Edition.

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IV SEMESTER (For Non Circuit Branches)						
COURSE CODE	**COURSE NAME**	**HOURS/WEEK**			**CREDIT**	**MAXIMUM MARKS**
		L	**T**	**P**	**C**	
22CY11001	**ENVIRONMENTAL SCIENCE AND ENGINEERING**	3	0	0	0	**100**

Objectives	To make the students familiar with: • The importance of Ecosystem and Natural resources. • The basic concepts of biodiversity and emphasize on the biodiversity of India and its conservation. • The causes, effects and prevention measures of environmental Pollution. • The influence of societal use of resources on the environment and introduce the legal provisions, National and International laws and conventions for environmental protection. • The effect of population dynamics on human and environmental health and inform about human right, value education and role of technology in monitoring human and environmental issues.
Outcomes	At the end of the course the student will be able to ❖ Explain basic knowledge about the importance of environment, ecosystem and Natural resources. ❖ Classify the biodiversity and measure the variety of animals, plants and microbial species. ❖ Identify the awareness about the different types of Pollution and know about control measures. ❖ Organize the environmental impacts related to the society through WHO. ❖ Explore the awareness about population explosion, human welfare and role of information technology in environment.

UNIT-I	**ENVIRONMENT, ECOSYSTEM AND NATRUAL RESOURCES**	**(12)**

Definition, scope and importance of environment – Need for public awareness – Concept of an ecosystem – Structure and Function of an ecosystem – Energy flow in the ecosystem– Ecological succession – food chains, food webs and ecological pyramids –Natural resources –Types and associated problems (Forest, Water, Food, Mineral and Energy resources).

UNIT-II	**BIODIVERSITY & CONSERVATION**	**(6)**

Introduction to biodiversity definition: genetic, species and ecosystem diversity – value of biodiversity – India as a mega- diversity nation – hot-spots of biodiversity – threats to biodiversity – endangered and endemic species of India – Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity – Field visit to local area.

UNIT-III	**ENVIRONMENTAL POLLUTION**	**(9)**

Definition – causes, effects and control measures of: (a)Air, (b)Water, (c)Soil, (d)Noise, (e)Thermal pollution – solid waste management: causes, effects and control measures of municipal solid wastes – disaster management: floods, earthquake and landslides – role of an individual in prevention of pollution – pollution case studies (vizag

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gas leakage) – Field visit to local polluted area.		
UNIT-IV	**SOCIAL ISSUES AND THE ENVIRONMENT**	**(9)**
From unsustainable to sustainable development – water conservation strategy – Feature of LARR Act - Rights of a property holder - role of non - governmental organizations- environmental ethics: Issues and possible solutions – climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies (Global warming) –Waste land reclamation – consumerism and waste products – environment protection act.		
UNIT-V	**HUMAN POPULATION AND THE ENVIRONMENT**	**(9)**
Definition – Population growth - variation among nations – population explosion – family welfare program - women and child welfare – environment and human health – human rights – value education – HIV/AIDS – role of information technology in environment and human health.		
		45 Periods

TEXTBOOKS

1.	Gilbert M. Masters, "Introduction to Environmental Engineering and Science", 3rd Edition, Pearson Education, 2023.
2.	Benny Joseph, "Environmental Science and Engineering", Tata McGraw-Hill, New Delhi, 2017.
3.	Dr. A. Ravikrishnan, "Environmental Science and Engineering", Sri Krishna Hi-tech Publishing Company Pvt. Ltd. Chennai, 2014.
4.	Anubha Kaushik, C. P. Kaushik "Perspectives in Environmental Studies", 7th Edition, NEW AGE International Publishers, 2021.

REFERENCE

1.	R.K.Trivedi, "Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards", Vol. I and II, Enviro Media.
2.	Rajagopalan , R, "Environmental Studies – From Crisisto Cure", Oxford University Press (2015).
3.	Dharmendra S. Sengar, "Environmental law", Prentice hall of India PVT LTD, New Delhi, 2007.

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Department	Mechatronics	Programme Code	1101

IV Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT24401	DYNAMICS LABORATORY	0	0	3	1.5	100

Objective(s)	• To supplement the principles learnt in Dynamics of Machinery to understand how certain measuring devices are used for dynamic testing. • To study the inertia effect of components. • To study the principles in mechanisms used for speed control and stability control. • To understand the effect of Dynamics of undesirable vibrations and to understand the effect of damping. • To study the undesirable effects of unbalances resulting from prescribed motions in mechanism.
Outcome(s)	At the end of the course, the students will be able to 1. Explain gear parameters, kinematics of mechanisms, and working of lab equipments. 2. Determine mass moment of inertia of mechanical element, natural frequency. 3. Determine the gyroscopic effect and governor effort and range sensitivity. 4. Determine the damping coefficient, torsional frequency, critical speeds of shafts.

LIST OF EXPERIMENTS

1.	a) Study of gear parameters. b) Experimental study of velocity ratios of Epicyclic gear train.
2.	Kinematics of Four Bar Mechanism.
3.	Kinematics of Slider Crank Mechanism.
4.	Determination of Mass moment of inertia of connecting rod.
5.	Motorized gyroscope – Study of gyroscopic effect and couple.
6.	Governor - Determination of range sensitivity, effort etc., for Proell Governor.
7.	Single degree of freedom Spring Mass System – Determination of natural Frequency and verification of Laws of springs – Damping coefficient determination.
8.	Transverse vibration of Free-Free beam – with and without concentrated masses.
9.	Vibration of Equivalent Spring mass system – undamped and damped vibration.
10.	Whirling of shafts – Determination of critical speeds of shafts with concentrated loads.
11.	Balancing of rotating masses.

Total hours to be taught **30 Periods**

Dr. T.JESUDAS, M.E., Ph.D
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Department	Mechatronics	Programme Code	1101

IV Semester

Course Code	Course Name	Hours/Week			Credit	Maximum marks
		L	T	P	C	
22MT24402	MANUFACTURING TECHNOLOGY LABORATORY	0	0	3	1.5	100

Objective(s)

- Demonstration and study of the various machines.
- Able to use lathe machine for different machining processes.
- Able to use shaping / slotting machine for different machining processes.
- Able to use hobbing machine for different machining processes.
- Able to manufacture tools using cutter grinder.

Outcome(s)

After completing the course the student will be able to

1. Demonstrate skills to machine cylindrical components using Lathe.
2. Exhibit skills to cut spur gear using gear hobbing and milling machine.
3. Express skills to do grinding operation in cylindrical grinding machine.

LIST OF EXPERIMENTS

1.	Turning – Step and Taper
2.	Thread Cutting
3.	Knurling and counter sinking
4.	Drilling, Taping and Reaming
5.	Surface Milling
6.	Spur Gear Cutting
7.	Helical Gear Cutting
8.	Cutting Key Ways
9.	Machining V- block
10.	Surface Grinding

Total hours to be taught **30 Periods**

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V SEMESTER

Regulation 2022							
V Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MT14501	Applied Hydraulics and Pneumatics	PC	3	1	0	4
2	22MT14502	Microprocessor and Microcontroller	PC	3	0	0	3
3	22MT14503	Automotive Electronics	PC	3	0	0	3
4		Professional Elective – 2	PE	3	0	0	3
5	22MA12501	Interpretation Analysis and Critical Thinking Skills	OE	3	0	0	3
6		Open Elective – 4	OE	3	0	0	3
PRACTICAL							
7	22MT24501	Automation Laboratory	PC	0	0	3	1.5
8	22MT24502	Microprocessor and Microcontroller Laboratory	PC	0	0	3	1.5
9	22EN60002	Interview Skills and Soft Skills	EEC	0	1	2	2
		TOTAL		**18**	**2**	**8**	**24**

Dr. T.JESUDAS, M.E., Ph.D
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Mahendra Engineering College
Mallasamudram, Namakkal

Department	Mechatronics	Programme Code			1101	
V Semester						
Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT14501	APPLIED HYDRAULICS ANDPNEUMATICS	3	1	0	4	100

Objective(s)

- Know the fundamental principles, design and operation of hydraulic and pneumatic components and systems.
- To impart knowledge about Classification of hydraulic actuators and valves.
- Basic concepts of fluid power system design - Hydraulic oils and Hydraulic circuit.
- Describe the basic function, structure, and operation of pneumatic components' and pneumatic power system design.
- Identify possible causes of some common hydraulic component and system failures.

Outcome(s)

The students will be able to

1. Explain the fluid power system and its fundamentals.
2. Identify suitable hydraulic actuators for different applications.
3. Choose the suitable fluid power control components for various applications.
4. Choose the suitable pneumatic components for different applications.
5. Design fluid power circuit for given applications.

UNIT-I FLUID POWER PRINCIPLES AND HYDRAULIC PUMPS (9+3)

Introduction to Fluid power- Advantages and Applications- Fluid power systems – Types of fluids- Properties of fluids – Basics of Hydraulics – Pascal's Law- Principles of flow – Friction los- Work, Power and Torque. Problems Sources of Hydraulic power: Pumping Theory – Pump Classification- Construction, Working, Design, Advantages, Disadvantages, Performance, Selection criterion of Linear, Rotary- Fixed and Variable displacement pumps-Problems.

UNIT-II HYDRAULIC ACTUATORS AND VALVES (9+3)

Hydraulic Actuators: Cylinders– Types and construction, Application, Hydraulic cushioning – Hydraulic motors Control Components: Direction control, Flow control and Pressure control valves- Types, Construction and Operation- Servo and Proportional valves - Applications – Types of actuation. Accessories: Reservoirs, Pressure Switches- Applications- Fluid Power ANSI Symbols – Problems.

UNIT-III HYDRAULIC SYSTEMS (9+3)

Accumulators, Intensifiers, Industrial hydraulic circuits- Regenerative, Pump Unloading, Double-pump,Pressure Intensifier, Air-over oil, Sequence, Reciprocation, Synchronization, Fail-safe, Speed control, Hydrostatic transmission, Electro hydraulic circuits, Mechanical Hydraulic servo systems.

UNIT-IV PNEUMATIC SYSTEMS (9+3)

Properties of air– Perfect Gas Laws- Compressors- Filter, Regulator, Lubricator, Muffler, Air control Valves,Quick Exhaust valves, Pneumatic actuators, Design of pneumatic circuit cascade method- Electro pneumatic circuits, Introduction to Fluidics, Pneumatic logic circuits.

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Mallasamudram, Namakkal

UNIT-V	ADVANCEMENTS IN FLUID POWER ENGINEERING	(9+3)

Overview of hydro pneumatics; Industrial internet of things for monitoring, control and diagnostics of systems for fluid power applications.

Programmable Logic Controller: Construction, programming methods, timers and counters; Programming using ladder logic diagrams.

Total hours to be taught	**60 Periods**

TEXT BOOK:

1	Anthony Esposito, "Fluid Power with Applications", Prentice Hall, 2009.

REFERENCES:

1	Shanmugasundaram.K, "Hydraulic and Pneumatic Controls", Chand & Co, 2006.
2	Majumdar, S.R., "Oil Hydraulics Systems- Principles and Maintenance", Tata McGraw Hill,2001.

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code			1101	
V Semester						
Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT14502	MICROPROCESSOR AND MICROCONTROLLER	3	0	0	3	100

Objective(s)

The student should be made to:

- Study the Architecture of 8086 microprocessor.
- Learn the design aspects of I/O and Memory Interfacing circuits.
- Study the Architecture of 8051 microcontroller.
- Learn the design aspects of 8051 interfacing program using Microcontroller.
- Study the basics of Arduino Programming.

Outcome(s)

On the successful completion of the course, students will be able to

1. **Explain** the architecture and instruction set of 8086 Microprocessor and its configuration.
2. **Discuss** the functions of various interfacing IC.
3. **Explain** the architecture and instruction set of Microcontroller.
4. **Design** different interfacing applications using microcontrollers and peripherals.
5. **Construct** systems using Arduino programming for real time applications.

UNIT-I **8086 PROCESSOR AND CONFIGURATION** **(9)**

Introduction to 8086 – Microprocessor architecture – Addressing modes - Instruction set and assembler directives – Assembly language programming – Modular Programming - Linking and Relocation - Stacks - Procedures – Macros – Interrupts and interrupt service routines – 8086 signals – Basic configurations – System bus timing –System design using 8086 – IO programming

UNIT-II **8086 I/O INTERFACING** **(9)**

Memory Interfacing and I/O interfacing - Parallel communication interface – Serial communication interface – D/A and A/D Interface - Timer – Keyboard /display controller – Interrupt controller – DMA controller – Programming and applications - Case studies: Traffic Light control, LED display , LCD display, Keyboard display interface and Alarm Controller.

UNIT-III **MICROCONTROLLER** **(9)**

Architecture of 8051 – Special Function Registers (SFRs) - I/O Pins Ports and Circuits - Instruction set -Addressing modes - Assembly language programming.

UNIT-IV **8051 MICROCONTROLLER INTERFACING** **(9)**

Programming 8051 Timers - Serial Port Programming - Interrupts Programming – LCD & Keyboard Interfacing - ADC, DAC & Sensor Interfacing - External Memory Interface- Stepper Motor and Waveform generation.

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

UNIT-V	INTRODUCTION TO ARDUINO PROGRAMMING	(9)
Introduction to ARDUINO, ARDUINO History and Family – Data Types - Function Libraries – Different types of Sensors – Motor Control - Interfacing Modules – Programming Basics – Applications – Case studies.		
	Total hours to be taught	**45 Periods**

TEXT BOOKS:

1	Yu-Cheng Liu, Glenn A.Gibson, "Microcomputer Systems: The 8086 / 8088 Family - Architecture, Programming and Design", Second Edition, Prentice Hall of India, 2007.
2	Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, "The 8051 Microcontroller and Embedded Systems: Using Assembly and C", Second Edition, Pearson education, 2011.
3	Arduino Programming: The Ultimate Guide For Making The Best Of Your Arduino Programming Projects, Paperback – 7 December 2019 by Ryan Turner.

REFERENCE:

1	Doughlas V.Hall, "Microprocessors and Interfacing, Programming and Hardware", TMH, 2012.
2	**Microcontrollers:** Architecture, Programming, Interfacing and System Design by Rajkamal, Pearson Education India, 2009.

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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code	1101 & MCT

V Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT14503	AUTOMOTIVE ELECTRONICS	3	0	0	3	100

Objective(s)	• To know the basic idea about Engine system. • To know the various sensors used in automotive and it's working. • To understand the control systems for automobiles. • To know the working of various automotive safety systems. • To study the advanced systems in automotive industry.
Outcome(s)	Student will be able to 1. Know the basic idea about Engine system. 2. Know the various sensors used in automotive and its working. 3. Understand the control systems for automobiles. 4. Know the working of various automotive safety systems. 5. Study the advanced systems in automotive industry.

UNIT-I	**BASICS OF ENGINES**	**(9)**

Operating principles of IC engine – major engine components – engine cylinder arrangements – the ignition systems – Electronic ignition, direct ignition, injection systems – working of the carburetor – throttle body injection – Multipoint fuel injection.

UNIT-II	**SENSORS AND ACTUATORS**	**(9)**

Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall Effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, and vacuum operated actuator

UNIT-III	**DIGITAL POWERTRAIN & VECHILE MOTION CONTROL**	**(9)**

Introduction – Digital Engine Control, Features – Control Modes for fuel control – EGR Control – Electronic Ignition control – Integrated engine control – Representative cruise control system- Cruise control Electronics –ABS – Electronic suspension system – four-wheel steering.

UNIT-IV	**CHASSIS, COMFORT AND SAFETY SYSTEMS**	**(9)**

Traction control system – Cruise control system – electronic control of automatic transmission –antilock braking system – electronic suspension system – working of airbag and role of MEMS in airbag systems – centralizeddoor locking system – climate control of cars.

UNIT-V	**AUTOMOTIVE INSTRUMENTATIONS, DIAGNOSTICS & PROTECTION**	**(9)**

Modern automotive Instrumentation – I/O signal conversion – Display devices – flat panel display – CAN Network- Telematics – GPS Navigation – Electronics control system diagnostics – Model based sensor failuredetection

Total hours to be taught	**45 Periods**

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TEXT BOOK:	
1	Ribbens, "Understanding Automotive Electronics", 7th Edition, Elsevier, Indian Reprint, 2013.
REFERENCES:	
1	Tom Denton, “Automobile Electrical and Electronics Systems”, Edward Arnold Publishers,2000.
2	Barry Hollembeak, “Automotive Electricity, Electronics & Computer Controls”, DelmarPublishers, 2001.
3	Richard K. Dupuy “Fuel System and Emission controls”, Check Chart Publication, 2000.
4	Ronald. K. Jurgon, “Automotive Electronics Handbook”, McGraw-Hill, 1999.

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Mallasamudram, Namakkal

V Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MA12501	INTERPRETATION, ANALYSIS AND CRITICAL THINKING	2	1	0	3	100

Objectives

The students should be made do :

- To develop the students logical thinking skills and apply it in the real life scenarios.
- To learn the strategies of solving Quantitative ability problems.
- To enrich the verbal ability of the students.
- To strengthen the basic programming skills of placements
- Develop the skill of computation with sequences and series

Outcomes

At the end of the course the students will be able to:

- Identify the techniques to solve Image interpretation and Relationship.
- Use Techniques to solve Logical Reasoning questions
- Interpret data, manipulate and summarize the information in order to answer Critical questions.
- Identify the core skills associated with Critical Thinking.
- Apply the basic concepts to solve problems on Surds, Pipes, Cisterns, Permutation and Combination.

UNIT-I **VERBAL ABILITY** **9**

Attention to details – Verbal Reasoning test – Types of image interpretation – Relationship – Classification - Solved Problems.

UNIT-II **LOGICAL REASONING** **9**

Sentence Completion and Para Jumbles – Logical connectives - Types of Logical Relationship – Types of Syllogism – Logical Deductions using Venn diagram.

UNIT-III **DATA INTERPRETATION AND DATA SUFFICIENCY** **9**

Ages – Problems on Ages – Concepts and basics – Set Theory– Set Operation – types of sets – solved problems – Calendars – Odd days – Leap year – counting of odd days, finding exact date – Data interpretation – Tabulation – Bar graphs – Pie charts – Line graphs – Data sufficiency based on problems.

UNIT-IV **CRITICAL REASONING** **9**

Surface area – Cuboids – Cube – Cylinder – Cone – Sphere – Hemisphere – Alligation – Mean Price – Rule of Alligation - Boats and Streams - Speed in Down Stream and upstream - Stream in still water - Rate of Stream - Critical Reasoning – Solved Problems.

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Mallasamudram, Namakkal

UNIT -V	ARITHMETICAL ABILITY	9
Indices and Surds – Law's of Indices - Law's of Surds - Pipes and Cisterns – Problems based on In- let and Out-let, Part of tank filled, Time based problems - Permutation and Combination – Factorial – Number of Permutation – Number of Combination – Solved Problems.		
	TOTAL	**45 Hours**

TEXTBOOK :	
1.	"Quantitative Aptitude" – R.S. Aggarwal, S.Chand and Company Ltd, New Delhi – 110055.
2.	A Modern Approach to Verbal and Non-Verbal Reasoning by R.S.Aggarwal, S.Chand and Company Ltd (2012), New Delhi – 110055.

REFERENCES:	
1.	Test of Reasoning for Competitive Examinations, 4th Edition by Edgar Thorpe, Tata McGraw Hill Publication, 2010.
2.	Quantitative Aptitude for Competitive Examinations 4th Edition by Abhijit Guha, Tata McGraw Hill Publication (2010).

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Department	Mechatronics	Programme Code & Name	1101 & MCT

V Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT24501	AUTOMATION LABORATORY	0	0	3	1.5	100

Objective(s)	• To introduce and provide hand on experience to students to design and test hydraulic circuit to control press, flow etc., • To provide hands on experience to design and test the pneumatic circuit to perform basic operations. • To introduce the Automation studio software to simulate hydraulic, pneumatic and electrical circuit.
Outcome(s)	At the end of the course, the student should be able to: 1. Ability to design and test hydraulic, pneumatic circuits. 2. Use of Automation studio software for simulation of hydraulic, pneumatic and electrical circuits.

LIST OF EXPERIMENTS

1.	Design and testing of hydraulic circuits such as i. Pressure control ii. Flow control iii. Direction control iv. Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electrohydraulic Trainer.
2.	Design and testing of pneumatic circuits such as i. Pressure control ii. Flow control iii. Direction control iv. Circuits with logic controls v. Circuits with timers vi. Circuits with multiple cylinder sequences in Pneumatic Electro pneumatic Trainer.
3.	Simulation of basic hydraulic, pneumatic and electrical circuits using Automation studio software.
	Total hours to be taught **45 Periods**

Dr. T.JESUDAS, M.E., Ph.D
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Mahendra Engineering College
Mallasamudram, Namakkal

Department	Mechatronics	Programme Code & Name	1101 & MCT

V Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT24502	MICROPROCESSORS AND MICROCONTROLLERS LABORATORY	0	0	2	1	100

Objective(s)	• To Introduce ALP concepts, features and Coding methods. • Write ALP for arithmetic and logical operations in 8086 and 8051. • Differentiate Serial and Parallel Interface. • Interface different I/O's with Microprocessors.
Outcome(s)	At the end of the course, the student should be able to: 1. Write ALP Programs for fixed and Floating Point and Arithmetic operations. 2. Interface different I/O's with processor. 3. Generate waveforms using Microprocessors. 4. Execute Programs in 8051.

LISTOF EXPERIMENTS

8086 and 8051 Programs

1.	Programs for 16-bit arithmetic operations for 8086 (using Various Addressing Modes)
2.	Program for sorting an array for 8086.
3.	Program for searching for a number or character in a string for 8086.
4.	Program for string manipulations for 8086.
5.	Program for digital clock design using 8086.
6.	Interfacing ADC and DAC to 8086.
7.	Parallel communication between two microprocessors using 8255.
8.	Serial communication between two microprocessor kits using 8251.
9.	Interfacing to 8086 and programming to control stepper motor.
10.	Programming using arithmetic, logical and bit manipulation instructions of 8051.
11.	Program and verify Timer/Counter in 8051.
12.	Interfacing Matrix/Keyboard to 8051.
	Total hours to be taught **45 Periods**

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SEMESTER – V						
Course Code	**Course Name**	**Hours / Week**			**Credit**	**Maximum Marks**
		L	**T**	**P**	**C**	
22SH60002	**INTERVIEW SKILLS AND SOFT SKILLS**	0	1	2	2	100

Objectives	➢ To improve the learners reading fluency skills through extensive reading ➢ To encourage the students to enrich their writing skills for academic andprofessional purposes ➢ To help the learners obtain speaking skills in both formal and informal situation. ➢ To equip them with presentation skills needed for academic as well as workplacecontexts. ➢ To make them acquire interview skills to face challenges in the career aspects
Outcomes	**At the end of the course, the learners will be able to :** ➢ Analyse the content and apply knowledge and skills efficiently wherever necessary. ➢ Create profile and other essential documents. ➢ Demonstrate speaking skills effectively in academic and career contexts. ➢ Apply suitable formats and presentation skills professionally. ➢ Demonstrate soft skills effectively at the time of interview and workplace.

UNIT I	**9 Hrs**
Reading Comprehension - Reading Passages with Multiple Choice Questions - Reading for Gist, SentenceCorrection, Paragraph Writing – Narrative, Descriptive, Expository, Persuasive, Content Writing.	
UNIT II	**9 Hrs**
Job Application – Cover Letter and Resume, Etiquette – E-mail and Telephone, Listening Comprehension, Listening Dialogues – Workshop.	
UNIT III	**9 Hrs**
Self Introduction and Introducing others, Greeting, Apologies, Request – Formal and Informal, Group Discussion – Useful Phrases, Do's and Don'ts, Mock Group Discussion, Role Play, Situational baseddialogues.	
UNIT IV	**9 Hrs**
Presentation Skills – PPT Preparation, Importance of Verbal and Non-verbal Communication, Extempore,Public Speaking, Stage Presentation – Mock Presentation.	
UNIT V	**9 Hrs**
Interview skills – Face to Face interview, Telephonic Interview, Mock Interview – Frequently Asked Interview Questions.	
Total Hours	**45**

Textbook:

1	Raman, Meenakshi & Sangeeta Sharma, *Technical Communication: Principles and Practice*, Ed.III, Oxford University Press, New Delhi. 2015.

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References:	
1	Anderson, Paul V., *Technical Communication: A Reader-Centered Approach*. Cengage, New Delhi. 2008.
2	Muralikrishna, & Sunita Mishra, *Communication Skills for Engineers*, Pearson, New Delhi. 2011.
3	Sharma, Sangeetha & Binod Mishra, *Communication Skills for Engineers and Scientists*, PHI Learning, New Delhi. 2009.
4	Smith-Worthington, Darlene & Sue Jefferson, *Technical Writing for Success*, Cengage, Mason USA, 2007.

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VI SEMESTER

Regulation 2022							
VI Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MT14601	Programmable Logic Controller & its Applications	PC	3	1	0	4
2	22MT14602	Virtual Instrumentation	PC	3	0	0	3
3	22MT14603	Automation in Food Processing and Technology	PC	3	0	0	3
4	22MBAT6S06	Managerial Skills, Project and Quality Management	HS	3	0	0	3
5		Professional Elective – 3	PE	3	0	0	3
6		Open Elective – 5	OE	3	0	0	3
7	22MC60001	Constitution of India	MC	3	-	-	-
PRACTICAL							
8	22MT24601	PLC Laboratory	PC	0	0	3	1.5
9	22MT24602	Virtual Instrumentation Laboratory	PC	0	0	3	1.5
10	22MT34601	Presentation Skills and Technical Seminar	EEC	0	0	2	1
		TOTAL		**18**	**1**	**7**	**23**

Dr. T.JESUDAS, M.E., Ph.D
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Mahendra Engineering College
Mallasamudram, Namakkal

Department	Mechatronics	Programme Code & Name	1101 & MCT

VI Semester

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT14601	PROGRAMMABLE LOGIC CONTROLLER & ITS APPLICATIONS	3	1	0	4	100

Objective(s)

The student should be able

- To have knowledge on PLC.
- To acquire the knowledge on programming of PLC.
- To understand different PLC registers and their description.
- To have knowledge on data handling functions of PLC.
- To know how to handle analog signal and converting of A/D in PLC.

Outcome(s)

On the successful completion of the course, students will be able to

1. **Describe** the PLCs and their I/O modules.
2. **Develop** control algorithms to PLC using ladder logic etc.
3. **Outline** PLC registers for effective utilization in different applications.
4. **Compare** various types of PLC registers and instructions.
5. **Design** PID controller with PLC.

UNIT-I **PLC BASICS** **(9)**

PLC system, I/O modules and interfacing, CPU processor, programming equipment, programming formats, construction of PLC ladder diagrams, devices connected to I/O modules.

UNIT-II **PLC PROGRAMMING** **(9)**

PLC Programming simple instructions- Programming EXAMINE ON and EXAMINE OFF instructions- Electromagnetic control relays- Motor starters, Manually operated switches, Mechanically operated switches and Proximity switches- Output control devices, Latching relays- PLC ladder diagram- Converting simple relay diagram in to PLC relay ladder diagram.

UNIT-III **PLC REGISTERS** **(9)**

Characteristics of Registers, module addressing, holding registers, input registers, output registers. PLC Functions: Timer functions and Industrial applications, counters, counter function industrial applications, Arithmetic functions, Number comparison functions, number conversion functions.

UNIT-IV **PROGRAM CONTROL INSTRUCTIONS** **(9)**

Introduction, Master control Reset instructions, JUMP instruction and subroutines, immediate input and output, forcing external I/O address- Data Manipulating instructions; Manipulation, transfer operations, compare, manipulating programs- math instructions; Addition, Subtraction, Multiplication, Division.

UNIT-V **ANALOG PLC OPERATION** **(9)**

Analog modules and systems, Analog signal processing, multi bit data processing, analog output application examples, PID principles, position indicator with PID control, PID modules, PID tuning, PID functions.

Total hours to be taught **45 Periods**

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TEXT BOOK:	
1	Frank D. Petruzella, "Programmable Logic Controllers", McGraw-Hill Companies, 3rdEdition, March 2013.
2	Programmable Logic Controllers – Principle and Applications by John W. Webb and Ronald A. Reiss, Fifth Edition, PHI.
3	Programmable Logic Controllers – Programming Method and Applications by JR. Hackworth and F.D Hackworth Jr. – Pearson, 2004.
REFERENCES:	
1	Siemens "PLC Handbook".
2	Introduction to Programmable Logic Controllers- Gary Dunning-Cengage Learning. Programmable Logic Controllers –W.Bolton-Elsevier publisher.

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Department	Mechatronics				Programme Code & Name	1101 & MCT
VI Semester						
Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT14602	VIRTUAL INSTRUMENTATION	3	0	0	3	100

Objective(s)	The student should be able to: • Introduce the principle, programming technique with instrument interfaces and applications of virtual instruments and to understand the basics of data acquisition are introduced in mechatronics systems.
Outcomes	On the successful completion of the course, students will be able to 1. Understand the evolution, advantages, techniques, architecture and applications ofvisual instrumentation. 2. Acquiring knowledge on VI programming techniques. 3. Study about the basics of data acquisition. 4. Understanding the concept of common instrument interfaces with industrialapplications. 5. Study about the use of analysis tools with various applications.

UNIT-I	**REVIEW OF VIRTUAL INSTRUMENTATION**	**(9)**
Historical perspectives, advantages, block diagram and architecture of a virtual instrument, data -flow techniques,graphical programming in data flow, comparison with conventional programming.		
UNIT-II	**VI PROGRAMMING TECHNIQUES**	**(9)**
VIS and sub-VIS loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, localand global variables, string and file I/O.		
UNIT-III	**DATA ACQUISTION BASICS**	**(9)**
AOC.OAC. 010. Counters & timers. PC Hardware structure, timing. Interrupts OMA, software and hardwareinstallation.		
UNIT-IV	**COMMON INSTRUMENT INTERFACES**	**(9)**
Current loop, RS.232C/RS.485, GPIB, System buses, interface buses: USB, PCMCIA, VXI, SCXI, PXI, etc.,networking basics for office &. Industrial applications, Visa and IVI, image acquisition and processing. Motion control.		
UNIT-V	**USE OF ANALYSIS TOOLS**	**(9)**
Fourier transforms, power spectrum correlation methods, windowing & filtering, VI application in various fields.		
	Total hours to be taught	**45 Periods**

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TEXT BOOK:	
1	Gupta ," Virtual Instrumentation Using Lab view" 2nd Edition, Tata McGraw-Hill Education, 2010.
REFERENCE:	
1	Gary Jonson, "Labview Graphical Programming", Fourth Edition, McGraw Hill, New York, 2006.
2	Gupta.S., Gupta.J.P., "PC interfacing for Data Acquisition & Process Control", Second Edition,Instrument Society of America, 1994.
3	Sokoloff; "Basic concepts of Labview 4", Prentice Hall Inc., New Jersey 1998.

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Department	Mechatronics	Programme Code	1101 & MCT

VI Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT14603	AUTOMATION IN FOOD PROCESSING AND TECHNOLOGY	3	0	0	3	100

Objective(s)	• To study the Basic automation technique and process control parameters. • To impact knowledge of automation in food industry. • To equip the students with the various Instruments in food processing. • To acquaint the automation techniques in fruit and vegetables process. • To acquaint the automation techniques in meat and poultry process.
Outcome(s)	Student will be able to 1. Gain knowledge in automation and process control parameters. 2. Understand the automation process in food industry. 3. Know the various instruments in food processing. 4. Study the automation techniques in fruit and vegetables process. 5. Study the automation techniques in meat and poultry process.

UNIT-I	**INTRODUCTION TO AUTOMATION AND PROCESS CONTROL**	**(9)**
Introduction to process control, identification, variables, Strategies, laws Block and physical diagram of control systems, open and closed loop, feedback and forward controls pneumatic and electronic controllers. Measuringelement controller and final control elements; P, PI, PID controls.		
UNIT-II	**AUTOMATION IN FOOD INDUSTRY**	**(9)**
Automatic process control in food industry. Process control methods in food industry, current, future trends.Robotics in food industry, specification of food sector robot.		
UNIT-III	**INSTRUMENTATION IN FOOD PROCESSING**	**(9)**
Instrumentation in food processing, sensors for automation, measurement methods, applications, machine vision,optical sensors and spectroscopic techniques. SCADA; standards, application and implementation.		
UNIT-IV	**AUTOMATION IN FRUIT AND VEGETABLES PROCESS**	**(9)**
Automation in sorting, thermal processing, fresh produce: Automation in bulk sorting; principles, requirements. Automation in food chilling and freezing; in storage, transport, retail systems automationin fruit vegetable processing; cleaning, grading, canning.		
UNIT-V	**AUTOMATION IN MEAT AND POULTRY PROCESS**	**(9)**
Automation in packaging and meat, poultry, fish processing: Automation in meat processing, carcass production, separation; before and after chilling. Automation in poultry industry; hanging, conveying, processing, packing Automation in sea food processing, in unit operations associated. Automation in packaging of food products.		
Total hours to be taught		**45 Periods**

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TEXT BOOKS:	
1	Robotics and Automation in the Food Industry by D Caldwell, Elsevier Science, Wood head Publishing.
2	Eackman DP. 1972. Automatic Process Control. Wiley Eastern.
REFERENCE:	
1	George Stephanopoulos, "Chemical Process Control", Prentice Hall of India, 1990.
2	Luyben, W. L, Process Modeling, Simulation and Control for Chemical Engineers, McGraw hill, 1973.
3	Considine DM. 1974. Process Instruments and Controls. Mc-Graw-Hill.
4	Thermal Processing of Foods: Control and Automation by K. P. Sandeep March 2011, Wiley-Blackwell.
5	Gouri S Mittal, “Computerized control system in the food industry”, Marcel Decker Inc. 1997.

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Regulations 2022						
Department	**Mechatronics**	**Programme Code**				**1101 & MCT**
Course Code	**Course Name**	**Hours/Week**			**Credit**	**Maximum Marks**
22MBAT6S06	**Managerial Skills, Project and Quality Management**	**L**	**T**	**P**	**C**	**100**
		3	**0**	**0**	**3**	

VI Semester

Objectives	This course is designed to: 1. Develop knowledge and skills needed for the successful managerial performance. 2. Develop team building and communication skills in learners for working in multi-disciplinary teams. 3. Enable the learners to plan, schedule and manage projects. 4. Facilitate budgeting and finance, and evaluate projects 5. Understand the importance of quality concepts and principles.
Outcomes	Upon completion of this course, the Learners will be able to : CO1: Demonstrate applicable knowledge and skills needed for managerial effectiveness. CO2: Demonstrate team building and communication skills for working in multi-disciplinary teams. CO3: Plan, schedule and manage projects CO4: Plan budgeting, manage finance and evaluate projects CO5: Summarize the quality concepts and principles.

UNIT-I	**INTRODUCTION TO MANAGERIAL SKILLS**	**9**

Introduction to Self Awareness – Self Portrait – Self Assessment – Life-long learning. Definition of Life Skills and Managerial Skills – Need and Importance of Skills. Decision Making and Problem Solving: Problem Analysis –Techniques – Steps; Problem solving: Characteristics of Complex problems – Problem Solving Strategies – Barriers.; Lateral thinking Need and Importance of Lateral Thinking; Logic and Rationality – Functions – Personal and Work ethics.

UNIT-II	**TEAM BUILDING AND EFFECTIVE COMMUNICATION**	**9**

Team Building: Developing teams and team work, advantages of team, leading team, team membership, traits of working in multi-disciplinary teams. Effective Communication: Need and Importance – Techniques and Types - Verbal and Non-Verbal Communication - Barriers to communication – Overcoming barriers – Multiple Intelligences – 360 degree evaluation, Case Study.

UNIT-III	**PROJECT MANAGEMENT**	**9**

Project: Meaning and Importance of terms 'Event', Activity'. 'Time". Identification of project opportunities, Screening of Project Ideas. Criteria for project selection, Project planning and scheduling – Application of CPM and PERT – Examples and case studies.

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UNIT-IV	**BUDGETING AND FINANCE**	**9**
Introduction to Budgeting and Finance, kinds of Project Evaluation, Evaluation Techniques – Non-discounted cash flow methods, Discounted cash flow Methods, Evaluation of Project cost, Capital budgeting and its methods. Financial management of Projects. Project Risk and its mitigation – Examples and case studies.		
UNIT-V	**QUALITY CONCEPTS AND PRINCIPLES**	**9**
Introduction - Need for Quality - Evolution of Quality - Definition of Quality - Dimensions of Manufacturing Quality and Service Quality. TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward Performance appal - Continuous process improvement, 6σ, 5s, Kaizen - Case Study.		
	Total	**45 HOURS**

TEXTBOOKS:	
1	David A.Whetten and Kim S.Cameron, Developing Management Skills, – PHI, 2011.
2	Harper, Nancy Life Skills: Essential for Personal Growth on the Ever Changing Road of Life. Bloomington, IN: Author House, 2011.
3	Adair, J. Decision Making and Problem Solving. UK: Kogan Page Publishers.2013.
4	James R Evans, Quality Management, Cengage Learning India Private Limited 2010.
5	Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
REFERENCES:	
1	Kallet, Michael Think Smarter: Critical Thinking to Improve Problem-Solving and Decision Making Skills. New Jersey: John Wiley & Sons, 2014.
2	Adair, J. & Allen, M. Time Management and Personal Development. London: Hawksmere, 1999.
3	Hattie, John Self-Concept. New York: Psychology Press, 2014.
4	Mcgrath E.H., S.J., Basic Managerial Skills for all, 9th Edition, PHI, 2012
5	Amitava Mitra, Fundamentals of Quality Control & Improvement, Wiley Publications, 2012.

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Department	MECHATRONICS	Programme Code	1101

VI Semester

Course code	Course Name	Periods/week			Credit	Maximum marks
		L	T	P	C	
22MC60001	CONSTITUTION OF INDIA	3	0	0	-	100

Objectives

- To know about the salient features of the Constitution of India.
- To gain knowledge about structure and functions of Union Government.
- To learn about the structure and functions of State Government.
- To understand about amendments in Indian Constitution, Judicial review.
- To study in detail about the Indian society.

Outcomes

On completion of the course, the learners should be able to:

- Summarize the features of the Indian Constitution and observe the fundamental duties, rights and responsibilities.
- Explain the functioning of Indian parliamentary system at the Center and the responsibilities of important functionaries.
- Describe the functioning of State Government and important functionaries.
- Recognize Amendments in Indian Constitution and Judicial review.
- Illustrate the composition and features of Indian society.

UNIT-I	INTRODUCTION ABOUT INDIAN CONSTITUTION	9

Historical Background – Constituent Assembly of India – Role and salient features - Philosophical foundations of the Indian Constitution – Preamble – Fundamental Rights – Directive Principles of State Policy – Fundamental Duties – Citizenship – Constitutional Remedies for citizens.

UNIT-II	STRUCTURE AND FUNCTION OF UNION GOVERNMENT	9

Parliamentary system – Legislature, Executive. Union Government – Structures of the Union Government. Functions and Responsibilities of President – Vice President – Prime Minister – Cabinet – Council of Ministers, Union Territories.

UNIT-III	STRUCTURE AND FUNCTION OF STATE GOVERNMENT	9

State Legislature - State Government – Structure and Functions – Governor – Chief Minister – Cabinet – Special Provisions (Article 370. 371, 371J) for some States. Judicial System in States – High Courts and other Subordinate Courts, Judicial review.

UNIT-IV	CONSTITUTION FUNCTIONS, AMENDMENTS AND REVIEW	9

Indian Federal System – Centre-State Relations – President's Rule – Assessment of working of the Parliamentary System in India - Constitutional Amendments – Methods in Constitutional Amendments (How and Why) and Important Constitutional Amendments. Amendments – 7,9,10,12,42,44, 61, 73, 74, 75, 86, and 91, 94, 95, 100, 101, 118. Savior of the Constitution – The Supreme Court of India – The Hon'ble Chief Justice of India and Hon'ble Judges of the Supreme Court. Judicial Review of Parliamentary and Executive functions.

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UNIT-V	INDIAN SOCIETY	9
Society : Nature, Meaning and definition; Indian Social Structure; Caste, Religion, Language in India; Constitutional Remedies for citizens – Political Parties and Pressure Groups; Right of Women, Children and Scheduled Castes and Scheduled Tribes and other Weaker Sections - Special Constitutional Provisions for SC & ST, OBC, Special Provision for Women, Children & Backward Classes.		
	TOTAL PERIODS	**45**

TEXTBOOKS:	
1	Durga Das Basu, "Introduction to the Constitution of India ", Prentice Hall of India, New Delhi
2	R.C.Agarwal, (1997) "Indian Political System", S.Chand and Company, New Delhi.
3	Maciver and Page, " Society: An Introduction Analysis ", Mac Milan India Ltd., New Delhi.
4	K.L.Sharma, (1997) "Social Stratification in India: Issues and Themes", Jawaharlal Nehru University, New Delhi.
REFERENCES:	
1	Sharma, Brij Kishore, "Introduction to the Constitution of India:, Prentice Hall of India, New Delhi.
2	U.R.Gahai, "Indian Political System ", New Academic Publishing House, Jalaendhar
3	R.N. Sharma, "Indian Social Problems ", Media Promoters and Publishers Pvt. Ltd.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

VI Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT24601	PLC LABORATORY	0	0	3	1.5	100

Objective(s)

- Identify the basic components of the control board.
- Assemble and arrange a simple control board.
- Explain the operation of electromagnetically controlled circuits.
- Operate simple loads using relays, switches and pushbuttons.

Outcome(s)

After successfully completing this laboratory, you should be able to:

- Convert a simple electrical ladder diagram to a PLC program.
- Know the difference between physical components and program components.
- Sketch the ladder programs using the tools available in Pico-Soft.
- Operate the program, via placing the PLC in the RUN mode.

LIST OF EXPERIMENTS

1.	Study of PLC.
2.	Simulation of logic gates using PLC.
3.	Simulation of Boolean Expression using PLC
4.	Sequential switching of motors using PLC – Simulation.
5.	Tank level control using PLC – simulation.
6.	Traffic light controller using PLC-Simulation.
7.	Testing of Relays- Simulation.
8.	Simulation of Timer using PLC.
9.	Simulation of Counter using PLC.
10.	Simulation of Flip – Flops using PLC.
11.	Automated Conveyor System using PLC.
12.	Modeling and simulation of pneumatic and hydraulics systems using PLC.
	Total hours to be taught **45 Periods**

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Department	Mechatronics	Programme Code & Name	1101 & MCT

VI Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT24602	VIRTUAL INSTRUMENTATION LABORATORY	0	0	3	1.5	100

Objective(s)	• Understanding Virtual Instrumentation Concepts. • Learning Graphical Programming • Data Acquisition and Control
Outcome(s)	After successfully completing this laboratory, you should be able to: • Ability to design and implement virtual instruments • Apply virtual instrumentation techniques to solve practical engineering challenges.

LIST OF EXPERIMENTS

1.	Creating Virtual Instrumentation for simple applications.
2.	Programming exercises for loops and charts.
3.	Programming exercises for clusters and graphs.
4.	Programming exercises on case and sequence structures, file Input / Output.
5.	Data Acquisition through Virtual Instrumentation.
6.	Developing voltmeter using DAQ cards.
7.	Developing signal generator using DAQ cards.
8.	Simulating reactor control using Virtual Instrumentation.
9.	Real time temperature control using Virtual Instrumentation.
10.	Real time sequential control of any batch process.
	Total hours to be taught: **45 Periods**

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MAHENDRA ENGINEERING COLLEGE (Autonomous)			R-2022
Syllabus			
Department	Mechatronics	Programme Code	1101
VI Semester			

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT34601	PRESENTATION SKILLS AND TECHNICAL SEMINAR	0	0	4	2	100

Objective(s)	• To encourage the students to study advanced engineering developments. • To prepare and present technical reports. • To encourage the students to use various teaching aids such as over head projectors,power point presentation and demonstrative models.
Outcome(s)	At the end of the course, the student should be able to: 1. Ability to review, prepare and present technological developments. 2. Ability to face the placement interviews.

- During the seminar session each student is expected to prepare and present a topic on engineering/technology, for duration of about 8 to 10 minutes.
- In a session of three periods per week, 15 students are expected to present the seminar.
- Each student is expected to present at least twice during the semester and the student is evaluated basedon that.
- At the end of the semester, he / she can submit a report on his / her topic of seminar and marks are givenbased on the report.
- A Faculty guide is to be allotted and he / she will guide and monitor the progress of the student andmaintain attendance also.
- Evaluation is 100% internal and External.

Total hours to be taught	30 Periods

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VII SEMESTER

Regulation 2022							
VII Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
THEORY							
1	22MT14701	Robotics and Industrial Automation	PC	3	1	0	4
2	22MT14703	Automation in Textile Industry	PC	3	0	0	3
3	22MT14704	CNC Machining Technology	PC	3	0	0	3
4		Professional Elective- 4	PE	3	0	0	3
5		Professional Elective- 5	PE	3	0	0	3
6		Professional Elective- 6	PE	3	0	0	3
PRACTICAL							
7	22MT24701	Robotics Laboratory	PC	0	0	3	1.5
8	22MT24702	Computer Aided Design and Analysis Laboratory	PC	0	0	3	1.5
9	22MT34701	Project Work (Phase - 1)	EEC	0	0	6	3
		TOTAL		**15**	**0**	**12**	**25**

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Department	Mechatronics	Programme Code			1101 & MCT	
VII Semester						
Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT14701	ROBOTICS AND INDUSTRIAL AUTOMATION	3	1	0	4	100

Objective(s)	• To understand the basics of robotics, drives and power transmission system. • To understand the different types and mechanisms of robotic end effectors and grippers. • To understand the fundamental mechanics of Robot Kinematics and Dynamics • To understand the fundamentals of machine vision, image acquisition and processing techniques. • To understand the basics of robot programming and different types of languages.
Outcome(s)	• Express the basic concepts, laws, drives and power transmission system. • Explain the types of grippers and end effectors and its functions. • Evaluate the kinematic calculations and apply Lagrangian and Newton-Euler methods to analyze Dynamic characteristics of robots. • Summarize the Basis of machine vision and apply the concept of image processing. • Describing the various programming techniques used in industrial robots.

UNIT-I	**BASICS OF ROBOTICS**	**(9+3)**
Introduction- Basic components of robot-Laws of robotics- classification of robot-work space-accuracy-resolution –repeatability of robot. Power transmission system: Electric drive, Hydraulic drive, Pneumatic drive.		
UNIT-II	**ROBOT END EFFECTORS**	**(9+3)**
Robot End effectors: Introduction- types of End effectors- Mechanical griper- types of griper mechanism- griperforce analysis- other types of griper- special purpose gripers.		
UNIT-III	**ROBOT MECHANICS**	**(9+3)**
Robot kinematics: Introduction- Matrix representation- rigid motion & homogeneous transformation forward & inverse kinematics- trajectory planning. Robot Dynamics: Introduction – Manipulator dynamics – Lagrange - Euler formulation- Newton - Euler formulation.		
UNIT-IV	**MACHINE VISION FUNDAMENTALS**	**(9+3)**
Machine vision: image acquisition, digital images-sampling and quantization-levels of computation Feature extraction-windowing technique- segmentation- Thresholding- edge detection- binary morphology - grey morphology.		
UNIT-V	**ROBOT PROGRAMMING**	**(9+3)**
Robot programming: Robot Languages- Classification of robot language-Computer control and robot software-Val system and Languages- application of robots.		
Total hours to be taught		**60 Periods**

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TEXT BOOK:	
1	M.P.Grover, M.Weis ,R.N. Nagal, N.G.Odrey, "Industrial Robotics - Technology, programming andApplications" Tata ,McGraw-Hill Education Pvt Limited, 2008.
REFERENCES:	
1	SathyaRanjan Deb, "Robotics Technology & flexible Automation" Sixth edition, Tata McGraw- HillPublication, 2003.
2	K.S.Fu, R.C.Gonzalez, C.S.G.Le, "Robotics: Sensing, Vision & Intelligence", Tata McGraw- Hill Publication, 1987.
3	John.J.Craig, "Introduction to Robotics: Mechanics & control", Second edition, 2002.
4	Jazar, "Theory of Applied Robotics: Kinematics, Dynamics and Control", Springer, Indian Reprint, 2010.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

VII Semester

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT14702	AUTOMATION IN TEXTILE INDUSTRY	3	0	0	3	100

Objective(s)

- To know the basic processing in textile industry.
- To understand the basics spinning process.
- To understand the basics of weaving process.
- To know the automation in spinning process.
- To know the automation in weaving process.

Outcome(s)

Student should able to

1. Know the basic processing in textile industry.
2. Understand the basics spinning process.
3. Understand the basics of weaving process.
4. Know the automation in spinning process.
5. Know the automation in weaving process.

UNIT-I **BASICS PROCESSING OF TEXTILE TECHNOLOGY** **(9)**

History of textile technology and its advancements, introduction to textile fibers, overview of textile manufacturing, Introduction to automation in textile industries. Objectives and process variables in processing machines: Singeing, Designing, Scouring, Bleaching, Mercerizing, Dyeing, Printing, Finishing.

UNIT-II **BASICS OF SPINNING** **(9)**

Spinning process flow chart – Objectives and process variables of textile spinning machineries: Mixing, Blowroom, Carding, Draw frame, Combing, Speed frame, Ring frame, rotor spinning.

UNIT-III **BASICS OF WEAVING** **(9)**

Weaving process flowchart – Objectives and process variables in weaving preparatory: Winding, Warping,Sizing and beaming. Objectives and process variables in weaving: drawing in, knotting, denting and weaving.

UNIT-IV **AUTOMATION IN SPINNING MACHINERY** **(9)**

Machinery material flow and its variation controls – Feeders & Stop motions – Auto levelers – Safety switches – Production and quality monitors – Full doff and pre-set length monitors. Data acquisition system for spinningpreparatory, ring spinning – rotor spinning. Application of CAD / CAM / CIM in spinning - Electronics data interchange.

UNIT-V **AUTOMATION IN WEAVING MACHINERY** **(9)**

Concept of state variables – State models for linear and time invariant Systems – Solution of state and output equation in controllable canonical form – Concepts of controllability and observability – Effect of state feedback-Digital PID controllers.

Total hours to be taught **45 Periods**

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REFERENCE:	
1	Chattopadhyay R. (Ed), "Advances in Technology of Yarn Production", NCUTE, IIT Delhi, 2002.
2	Oxtoby E "Spun Yarn Technology" butter worth‟s, London, New Edition 2002.
3	Lord P.R. and Mohammed M.H., "Weaving – Conversion of Yarn to Fabric", MerrowBPublication,2001.
4	Krishna Kant, "Computer – Based Industrial Control", PHI Learning Pvt Ltd, 2nd edition, New Delhi, 2011.
5	Venkatachalam. A and Ashok Kumar L, "Monograph on — Instrumentation & Textile Control Engineering" – 2005.
6	Berkstresser G A, Buchanan D R and Grady P, "Automation in the Textile Industry from Fibers to Apparel", The Textile Institute, UK, 1995.
7	"Textiles Go On-line", the textile Institute, UK, 1996.
8	Nalura B C. "Theory and Applications of Automation Controls" New Age International (P) Ltd Pub,1998.
9	Ormerod A, "Modern Development in spinning and Weaving Machinery",Butterworth‟s,1993.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

VII Semester

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT14703	CNC MACHINING TECHNOLOGY	3	0	0	3	100

Objective(s)

- Understand evolution and principle of CNC machine tools.
- Describe constructional features of CNC machine tools.
- Explain drives and positional transducers used in CNC machine tools.
- Write simple programs for CNC turning and machining centers and Generate CNCprograms for popular CNC controllers.
- Describe tooling and work holding devices for CNC machine tools.

Outcome(s)

The students will be able to

1. The students can able to understand evolution and principle of CNC machine.
2. The students expose to design for guide ways, ball screw, gears, timing belts and flexiblecouplings etc.,
3. The student may exposure drives and controls for CNC machine tools.
4. The student may analysis and writes the simple program for CNC machine.
5. The students can able to understand evolution and principle of CNC machine tools anddescribe constructional features of CNC machine tools.

UNIT-I	INTRODUCTION TO CNC MACHINE TOOLS	(9)

Evolution of CNC Technology, principles, features, advantages, applications, CNC and DNC concept, classification of CNC Machines – turning centre, machining centre, grinding machine, EDM, types of controlsystems, CNC controllers, characteristics, interpolators– Computer Aided Inspection.

UNIT-II	STRUCTURE OF CNC MACHINE TOOL	(9)

CNC Machine building, structural details, configuration and design, guide ways – Friction, Anti friction and othertypes of guide ways, elements used to convert the rotary motion to a linear motion – Screw and nut, recirculating ball screw, planetary roller screw, recirculating roller screw, rack and pinion, spindle assembly, torque transmission elements – gears, timing belts, flexible couplings, Bearings.

UNIT-III	DRIVES AND CONTROLS	(9)

Spindle drives – DC shunt motor, 3 phase AC induction motor, feed drives –stepper motor, servo principle, DC and AC servomotors, Open loop and closed loop control, Axis measuring system – synchro, synchro-resolver,gratings, moiré fringe gratings, encoders, inductosysn, laser interferometer.

UNIT-IV	CNC PROGRAMMING	(9)

Coordinate system, structure of a part program, G & M Codes, tool length compensation, cutter radius and toolnose radius compensation, do loops, subroutines, canned cycles, mirror image, parametric programming, machining cycles, programming for machining centre and turning centre for well-known controllers such as Fanuc,Heidenhain, Sinumerik etc., generation of CNC codes from CAM packages.

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UNIT-V	TOOLING AND WORK HOLDING DEVICES	(9)
Introduction to cutting tool materials – Carbides, Ceramics, CBN, PCD–inserts classification-PMK, NSH,qualified, semi qualified and preset tooling, tooling system for Machining centre and Turning centre, work holding devices for rotating and fixed work parts, economics of CNC, maintenance of CNC machines.		
	Total hours to be taught	**45 Periods**

TEXT BOOKS:

1	HMT, "Mechatronics", Tata McGraw-Hill Publishing Company Limited, New Delhi, 2005.
2	Warren S.Seamers, "Computer Numeric Control", Fourth Edition, Thomson Delmar, 2002.

REFERENCE:

1	James Madison, "CNC Machining Hand Book", Industrial Press Inc., 1996.
2	Ken Evans, John Polywka & Stanley Gabrel, "Programming of CNC Machines", Second Edition, Industrial Press Inc, New York, 2002.
3	Peter Smid, "CNC Programming Hand book", Industrial Press Inc., 2000.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

VII Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT24701	ROBOTICS LABORATORY	0	0	3	1.5	100

Objective(s)	• To introduce different types of robotics and demonstrate them to identify different parts and components. • To write programming for simple operations like pick and place, rotoxim etc.,
Outcome(s)	At the end of the course, the student should be able to: 1. Use of Adam's software and MAT Lab software to model the different types ofrobots and calculate work volume for different robots.

LIST OF EXPERIMENTS

1.	Study of different types of robots based on configuration and application.
2.	Study of different type of links and joints used in robots.
3.	Study of components of robots with drive system and end effectors.
4.	Determination of maximum and minimum position of links.
5.	Verification of transformation (position and orientation) with respect to gripper and world coordinate system.
6.	Estimation of accuracy, repeatability and resolution.
7.	Robot programming exercises.
	Total hours to be taught **45 Periods**

Dr. T.JESUDAS, M.E., Ph.D
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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code & Name	1101 & MCT

VII Semester

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT24702	CAD / CAM LABORATORY	0	0	3	1.5	100

Objective(s)	• To gain practical experience in handling 2D and 3D drafting software systems. • To gain practical experience in handling 3D modeling software systems. • To study the features of CNC Machine Tool. • To expose students to modern control systems. • To know the application of various CNC machines like CNC lathe, CNC VerticalMachining centre.
Outcome(s)	1. Draw 2D and 3D drawing using CAD software. 2. Draw 3D models and assemble the models using CAD software. 3. Can explain the features of CNC machines. 4. Demonstrate manual part programming with G and M codes using CAM for millingcentre. 5. Demonstrate manual part programming with G and M codes using CAM for turningcentre.

LIST OF EXPERIMENTS

1.	Modeling of a part using Pro-E /CATIA /UNIGRAPHICS.
2.	Modeling of a component using Pro-E /CATIA /UNIGRAPHICS.
3.	Modeling and assembling of the mechanical components using Pro-E/CATIA/UNIGRAPHICS.
4.	Modeling and assembling of the mechanical components using Pro-E/CATIA/UNIGRAPHICS.
5.	Modeling and assembling of the mechanical components using Pro-E/CATIA/UNIGRAPHICS.
6.	Modeling and assembling of the mechanical components using Pro-E/CATIA/UNIGRAPHICS.
7.	Modeling and tool path simulation using Master CAM (MIL) or any CAM package
8.	Modeling and tool path simulation using Master CAM (Lathe) or any CAM package.
9.	NC code generation for milling using Master CAM (MIL) or any CAM package.
10.	NC code generation for turning using Master CAM (Lathe) or any CAM package.

Total hours to be taught: **45 Periods**

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Department	Mechatronics			Programme Code & Name	1101 & MCT
VII Semester					
Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT34701	PROJECT WORK (PHASE – 1)	0	0	6	3	100
Objective(s)	• The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which isdesigned by them.					
Outcome(s)	At the end of the course, the student should be able to: 1. Use of design principles and develop conceptual and engineering design of anycomponents. 2. Ability to fabricate any components using different manufacturing tools.					

GUIDELINE FOR REVIEW AND EVALUATION

- The students may be grouped into 2 to 4 and work under a project supervisor.
- The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor andif possible with an industry.
- A project report to be submitted by the group and the fabricated model, which will be reviewed andevaluated for internal assessment by a Committee constituted by the Head of the Department.
- At the end of the semester examination the project work is evaluated based on oral presentation and theproject report jointly by external and internal examiners constituted by the Head of the Department.

Total hours to be taught	**30 Periods**

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VIII SEMESTER

Regulation 2022							
VIII Semester							
Sl. No.	**Course code**	**Course Title**	**Category**	**L**	**T**	**P**	**C**
PRACTICAL							
1	22MT34801	Project Work (Phase – 2)	PW	0	0	12	6
		TOTAL		**0**	**0**	**12**	**6**

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MAHENDRA ENGINEERING COLLEGE (Autonomous)			R-2022
Syllabus			
Department	**Mechatronics**	**Programme Code & Name**	**1101 & MCT**
VIII Semester			

Course Code	Course Name	Hours/Week			Credit	Maximum Marks
		L	T	P	C	
22MT34801	PROJECT WORK (PHASE -2)	0	0	12	6	100

Objective(s)	• The main objective is to give an opportunity to the student to get hands on training in the fabrication of one or more components of a complete working model, which is designed by them.
Outcome(s)	At the end of the course, the student should be able to: 1. Use of design principles and develop conceptual and engineering design of anycomponents. 2. Ability to fabricate any components using different manufacturing tools.

GUIDELINE FOR REVIEW AND EVALUATION

- The students may be grouped into 2 to 4 and work under a project supervisor.
- The device/ system/component(s) to be fabricated may be decided in consultation with the supervisor andif possible with an industry.
- A project report to be submitted by the group and the fabricated model, which will be reviewed andevaluated for internal assessment by a Committee constituted by the Head of the Department.
- At the end of the semester examination the project work is evaluated based on oral presentation and theproject report jointly by external and internal examiners constituted by the Head of the Department.

Total hours to be taught	**60 Periods**

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PROFESSIONAL ELECTIVES

Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15001	SENSORS AND SIGNAL PROCESSING	3	0	0	3	100

Objective(s)	• Students will be exposed to basics of sensors and the methods of processing their signals.
Outcome(s)	The students will be able to 1. Understand principle of working of various signal conditioners used with Temperature, Displacement, Optical and various miscellaneous other sensors. 2. Design signal conditioning circuits for various transducers. 3. Understand applications of various signal conditioners used in industry. 4. Capable of selecting best suited signal conditioners for any given application.

UNIT-I	**SCIENCE OF MEASUREMENT**	**(9)**
Units and Standards – Calibration techniques –Errors in Measurements – Generalized Measurement System – Static and dynamic characteristics of transducers – Generalized Performance of Zero Order and First Order Systems - Response of transducers to different time varying inputs – Classification of transducers.		
UNIT-II	**MECHANICAL MEASUREMENTS**	**(9)**
Temperature: Filled thermometer – Bimetallic thermometer – monometers – elastic transducers – bourdon gauge – bellows – diaphragm. Vacuum: McLeod gauge, thermal conductivity gauge – Ionization gauge, flow measurement: orifice, venture, nozzle, pilot tube, turbine flow meter, hot wire anemometer.'		
UNIT-III	**ELECTRICAL MEASUREMENT**	**(9)**
Resistive transducers – Potentiometer– RTD – Thermistor – Thermocouple – Strain gauges – use in displacement, temperature, force measurement – Inductive transducer – LVDT – RVDT – use in displacement – Capacitive transducer – Piezo electric transducer – Digital displacement transducers.		
UNIT-IV	**SMART SENSORS**	**(9)**
Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors – applications - Automobile, Aerospace, Home appliances, Manufacturing, Medical diagnostics, Environmental monitoring.		
UNIT-V	**SIGNAL CONDITIONING AND DATA ACQUISITION**	**(9)**
Amplification – Filtering – Sample and Hold circuits –Data Acquisition: Single channel and multi-channel data acquisition – Data logging.		
	Total hours to be taught	**45 Periods**

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TEXT BOOKS :	
1	Doebelin. E. O., "Measurement Systems – Applications and Design", Tata McGraw Hill, 1992
2	Patranabis. D, “Sensors and Transducers”, 2nd Edition PHI, New Delhi, 2003.
REFERENCE:	
1	Ian SinclaIr .R "Sensors and transducers", Newnes ,Elaiver Indian print 2011.
2	Beckwith, Marangoni and Lienhard, "Mechanical Measurements", Addison Wesley, 2000.
3	Venkatesan. S.P, "Mechanical Measurements", Ane Books Pvt Ltd, India 2008.

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Mallasamudram, Namakkal

Department	MECHATRONICS	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15002	COMPUTER AIDED DESIGN	3	0	0	3	100

Objective(s)

- To provide an overview of how computers are being used in mechanical component design.
- To learn the basic curves and modeling techniques.
- To know several techniques for removing hidden lines and surfaces.
- Use CAD software to generate a computer model and technical calculations for a simple, well-defined part or assembly.
- To know how the standards drawings are created and documented in CAD.

Outcome(s)

The students will be able to

1. Explain the 2D and 3D transformations, clipping algorithm, Manufacturing models and Metrics.
2. Explain the fundamentals of parametric curves, surfaces and Solids.
3. Able to add realism to pictures by eliminating hidden lines and surfaces on solid objects.
4. Generate and interpret engineering technical drawings of parts and assemblies according to engineering design standards.
5. Summarize the different types of Standard systems used in CAD.

UNIT-I	FUNDAMENTALS OF COMPUTER GRAPHICS	(9)

Product cycle- Design process- sequential and concurrent engineering- Computer aided design – CAD system architecture- Computer graphics – co-ordinate systems- 2D and 3D transformations homogeneous coordinates - Line drawing -Clipping- viewing transformation.

UNIT-II	GEOMETRIC MODELING	(9)

Representation of curves- Hermite curve- Bezier curve- B-spline curves-rational curves-Techniques for surface modeling – surface patch- Coons and bicubic patches- Bezier and B-spline surfaces. Solid modeling techniques- CSG and B-rep.

UNIT-III	VISUAL REALISM	(9)

Hidden – Line-Surface-Solid removal algorithms – shading – colouring – computer animation.

UNIT-IV	ASSEMBLY OF PARTS	(9)

Assembly modelling – interferences of positions and orientation – tolerance analysis-mass property Calculations – mechanism simulation and interference checking.

UNIT-V	CAD STANDARDS	(9)

Standards for computer graphics- **Graphical Kernel System** (GKS) - standards for exchange images- **Open G**raphics Library **(OpenGL)** - Data exchange standards - IGES, STEP, CALS etc. - Communication standards.

Total hours to be taught	**45 Periods**

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TEXT BOOK :	
1	Ibrahim Zeid “Mastering CAD CAM” Tata McGraw-Hill Publishing Co.2007.
REFERENCES:	
1	Chris McMahon and Jimmie Browne “CAD/CAM Principles", "Practice and Manufacturing management “ Second Edition, Pearson Education, 1999.
2	William M Neumann and Robert F.Sproul “Principles of Computer Graphics”, McGraw Hill Book Co. Singapore, 1989.
3	Donald Hearn and M. Pauline Baker “Computer Graphics”’. Prentice Hall, Inc, 1992.
4	Foley, Wan Dam, Feiner and Hughes - "Computer graphics principles & practice" Pearson Education - 2003.

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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15003	MICRO ELECTRO MECHANICALSYSTEMS	3	0	0	3	100

Objective(s)	• To know basic knowledge about MEMS system. • To study about micro sensors and actuators. • To study about fabrication process. • To design micro systems. • To study the material of MEMS system.
Outcome(s)	**The students should be able to** 1. List the different scaling laws used in micro system design. 2. Know the basic knowledge about MEMS system. 3. Describe the various working principles of micro sensor and micro actuators. 4. Summarize various micro system fabrication techniques. 5. Design the micro system.

UNIT-I	**INTRODUCTION**	**(9)**
Intrinsic Characteristics of MEMS – Energy Domains and Transducers- Sensors and Actuators – Introduction to Micro fabrication - Silicon based MEMS processes – New Materials – Review of Electrical and Mechanical concepts in MEMS – Semiconductor devices – Stress and strain analysis – Flexural beam bending- Torsional deflection.		
UNIT-II	**MICRO SENSORS AND ACTUATORS**	**(9)**
Working principle of Microsystems - micro actuation techniques - micro sensors-types -Micro actuators – types – micro pump – micro motors – micro – valves – micro grippers –micro-Accelerometers.		
UNIT-III	**SENSORS AND ACTUATORS-I**	**(9)**
Piezoresistive sensors – Piezo resistive sensor materials - Stress analysis of mechanical elements – Applications to Inertia, Pressure, Tactile and Flow sensors – Piezoelectric sensors and actuators – piezoelectric effects – piezoelectric materials – Applications to Inertia, Acoustic, Tactile and Flow sensors.		
UNIT-IV	**MICRO SYSTEM DESIGN**	**(9)**
Design considerations-process design-mask layout design- mechanical design-applications of micro systems inautomotive industry, bio medical, aerospace and telecommunications.		
UNIT-V	**POLYMER AND OPTICAL MEMS**	**(9)**
Polymers in MEMS– Polyimide - SU-8 - Liquid Crystal Polymer (LCP) – PDMS – PMMA – Parylene –Fluorocarbon - Application to Acceleration, Pressure, Flow and Tactile sensors- Optical MEMS – Lenses and Mirrors – Actuators for Active Optical MEMS.		
	Total hours to be taught	**45 Periods**

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TEXT BOOKS:	
1	Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2	Stephen D Senturia, 'Micro system Design', Springer Publication, 2000.
3	Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.
REFERENCES:	
1	NadimMaluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000.
2	Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC presBaco Raton, 2001.
3	Julian w. Gardner, Vijay K. Varadan, Osama O.Awadelkarim, Micro Sensors MEMS and Smart Devices,John Wiley & Son LTD, 2002.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15004	MACHINE VISION AND IMAGE PROCESSING	3	0	0	3	100

Objective(s)

The student should be made:

- To become familiar with digital image fundamentals.
- To get exposed to simple image enhancement techniques in Spatial and Frequencydomain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods.

Outcome(s)

On the successful completion of the course, students will be able to

1. Know the basics of digital image processing.
2. Understand the fundamentals of digitization, sampling, quantization, and 2D-transforms.
3. Operate on images using the techniques of smoothing, sharpening and enhancement.
4. Understand the restoration concepts and filtering techniques.
5. Learn the basics of segmentation, features extraction, compression and recognitionmethods for color models.

UNIT-I DIGITAL IMAGE FUNDAMENTALS (9)

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels - Color image fundamentals - RGB, HSI models, Two-dimensional mathematical preliminaries, 2D transforms - DFT, DCT.

UNIT-II IMAGE ENHANCEMENT (9)

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering– Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement.

UNIT-III IMAGE RESTORATION (9)

Image Restoration - degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering –Wiener filtering.

UNIT-IV IMAGE SEGMENTATION (9)

Edge detection, Edge linking via Hough transform – Thresholding - Region based segmentation – Region growing – Region splitting and merging – Morphological processing- erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm.

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UNIT-V	IMAGE COMPRESSION AND RECOGNITION	(9)
Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard,MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture - Patterns and Pattern classes - Recognition based on matching.		
Total hours to be taught		**45 Periods**

TEXT BOOKS:

1	Rafael C. Gonzalez, Richard E. Woods, 'Digital Image Processing', Pearson, Third Edition, 2010.
2	Anil K. Jain, 'Fundamentals of Digital Image Processing', Pearson, 2002.

REFERENCE:

1	Kenneth R. Castleman, 'Digital Image Processing', Pearson, 2006.
2	Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, 'Digital Image Processing using MATLAB',Pearson Education, Inc., 2011.
3	D,E. Dudgeon and RM. Mersereau, 'Multidimensional Digital Signal Processing', Prentice Hall Professional Technical Reference, 1990.
4	William K. Pratt, 'Digital Image Processing', John Wiley, New York, 2002.
5	Milan Sonka et al 'Image processing, analysis and machine vision', Brookes/Cole, Vikas PublishingHouse, 2nd edition, 1999.

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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15005	ARTIFICIAL INTELLIGENCE	3	0	0	3	100

Objective(s)	• To acquire knowledge about different searching techniques and algorithms. • To train the system in playing games. • To Study the concept of representing knowledge and facts using reasoning andstructures. • To study the concept of knowledge representation using modern logics. • To study the concept of structural knowledge representation.
Outcome(s)	Student should be able to 1. Explain the characteristics of AI systems with different searching techniques andalgorithms. 2. Develop algorithms to train the system in playing games. 3. Summarize the concepts of knowledge representation. 4. Design a simple AI System. 5. Understand the concept of structural knowledge representation.

UNIT I	**INTRODUCTION**	**(9)**
Definition – Pattern recognition – Criteria of success – Production Systems – Control Strategies – Heuristic Search – Problem Characteristics – Production System Characteristics – Forward and backward reasoning – Matching Indexing – Heuristic Functions, Search algorithms.		
UNIT II	**GAME PLAYING**	**(9)**
Overview – Minimax search procedure – Adding Alpha – Beta cutoffs – Waiting for Ouiescence – Secondarysearch – Using book moves.		
UNIT III	**KNOWLEDGE REPRESENTATION USING CONVENTIONAL LOGICS**	**(9)**
Use of Predicate logic – Introduction to representation – representing simple facts in logic augmenting the representation – resolution – Conversion to clause from – The basis of resolution Unification of algorithm –Question answering – Natural Deduction.		
UNIT IV	**KNOWLEDGE REPRESENTATION USING MODERN LOGICS**	**(9)**
Nonmonotonic reasoning – Statistical Probabilistic reasoning – Techniques for dealing with a random worldand deterministic world – rule-based system.		
UNIT V	**STRUCTURAL REPRESENTATIONS OF KNOWLEDGE**	**(9)**
Common knowledge structures – level of representation – Right structures – Declarative representations – Semantic nets – Conceptual dependency Frames Scripts – Procedural representation – Natural language understanding – Perception – learning – Implementation A.I. Systems.		
	TOTAL HOURS	**45 Periods**

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TEXT BOOKS:	
1.	Elaine Rich, "Artificial Intelligence", McGraw-Hill Book Co., 2009
2.	M. W. Richaugh, "Artificial Intelligence, A. Knowledge Based Approach", PWS Rent Publishing Boston, 1998
REFERENCE:	
1.	Charniac. E and M.C.Dermott. "Introduction to Artificial Intelligence", Addison Wesley Publishing Company, 2002
2.	Robert Goodell Brown, "Materials Management Systems – A Members Library", John Wiley Publishers, 1977.
3.	Westing Fine and Zone, "Purchasing Management Principles", John Wiley Publishers, 1986.

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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15006	ENGINEERING ECONOMICS AND COST ANALYSIS	3	0	0	3	100

Objective(s)	• Basics of economic analysis and cost analysis are introduced. • Method adopted for capital budgeting and depreciation estimation are introduced.
Outcome(s)	• The students will be able to carry out cost analysis for capital subjecting based on depreciation, money available, supply of material and demand of products in their management profession.

UNIT-I	**DEMAND AND SUPPLY ANALYSIS**	**(9)**

Nature and scope of engineering economics – definition and scope of study- importance of economic analysis in business. Demand and supply analysis – demand determinants- Law of demand – elasticity of demand – demandforecasting. Law of supply – elasticity of supply – market price.

UNIT-II	**COST ANALYSIS**	**(9)**

Types of cost - Fixed cost, variable cost, marginal cost. Cost output relationship in short and long run. Pricingdecisions – situations demanding pricing decisions, pricing techniques in practice – full cost pricing, marginal cost pricing, going rate pricing, bid pricing, price fixing for a rate of return. Statutory requirements.

UNIT-III	**MONEY AND BANKING**	**(9)**

Value of money – inflation – deflation, banking- commercial bank and its functions, central bank and its functions.New economic environment – globalization, liberalization and privatization.

UNIT-IV	**CAPITAL BUDGETING**	**(9)**

Ned for capital budgeting – method of apprising project profitability – rate of return method, payback periodmethod, present value comparisons method, cost benefit analysis. Preparation of feasibility report, appraisal process, economic and commercial feasibility, financial feasibility, technical feasibility.

UNIT-V	**DEPRECIATION AND COST ANALYSIS**	**(9)**

Causes of depreciation, objectives, methods of computing depreciation, simple problems. Breakeven analysis, breakeven point – assumptions, breakeven chart, uses of breakeven analysis, simple problems. Financial statements – cash flow statement, profit and loss account, balance sheet and evaluation of projected financial statements.

Total hours to be taught	**45 Periods**

TEXT BOOKS:

1	James L Rigs, David D. Bedworth, "Engineering Economics", Tata McGraw Hil, 1998.
2	Chandrasekar. K.S., "Marketing Management Text and Cases", 1st Edition, Tata McGraw Hill – Vijaynicole, 2010.

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REFERENCE:	
1	Varshney R and Maheswari K L, "Managerial Economics", S.Chand & Co, 1993
2	Samuelson P A and Nordhaus W D, "Economics", Tata McGraw Hill, 2001.
3	Prasanna Chandra, “Projects”, Tata McGraw Hill, 2003.
4	Patel Bhavesh. M, "Project Management, Strategic Financial Planing Evaluation and Control", Vikas Publishing House, New Delhi, 2000.

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Mallasamudram, Namakkal

Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15007	ENGINEERING MATERIALS AND METALLURGY	3	0	0	3	100

Objective(s)

- To impart knowledge on the structure, properties, treatment, testing and applications of metals and non-metallic materials so as to identify and select suitable materials for various engineering applications.

UNIT-I **CONSTITUTION OF ALLOYS AND PHASE DIAGRAMS** **(9)**

Constitution of alloys – Solid solutions, substitutional and interstitial – phase diagrams, Isomorphism, eutectoid, eutectic, peritectic, and peritectroid reactions, Iron – Iron carbon equilibrium diagram. Classification of steel and cast Iron, microstructure, properties and applications.

UNIT-II **HEAT TREATMENT** **(9)**

Definition – Full annealing, stress relief, re-crystallization and Spheroid zing –normalizing, hardening and tempering of steel. Isothermal transformation diagrams – cooling curves superimposed on I.T. diagram, CCR - Harden ability, Jominy end quench test – Austempering, Mar tempering – case hardening - carburizing, nit riding, cyaniding, Carbonitriding, flame and induction hardening.

UNIT-III **MECHANICAL PROPERTIES AND TESTING** **(9)**

Mechanism of plastic deformation, slip and twinning – Types of fracture – Testing of materials under tension, compression and shear loads – Hardness tests (Brinell, Vickers and Rockwell), Impact test - Izod and Charpy, Fatigue and creep tests, fracture toughness tests.

UNIT-IV **FERROUS AND NON FERROUS METALS** **(9)**

Effect of alloying elements on steel (M_n, Si, Cr, Mo, V, Ti & W) - stainless and tool steels – HSLA - maraging steels – Cast Irons - Grey, White malleable, Spheroidal – Graphite, Alloy cast irons, Copper and Copper alloys - Brass, Bronze and Cupronickel – Aluminum and Al-Cu alloy – precipitation hardening– Bearing alloys.

UNIT-V **NON-METALLIC MATERIALS** **(9)**

Polymers – types of polymer, commodity and engineering polymers – Properties and applications of PE, PP, PS, PVC, PMMA, PET, PC, PA, ABS, PI, PAI, PPO, PPS, PEEK, PTFE Polymers – Urea and Phenol Formaldehydes – Engineering Ceramics – Introduction to Fiber reinforced plastics.

Total hours to be taught **45 PERIODS**

TEXT BOOK :

1 Kenneth G.Budinski and Michael K.Budinski “Engineering Materials” Prentice-Hall of India Private Limited, 4th Indian Reprint 2002.

REFERENCES:

1 William D Callister “Material Science and Engineering”, John Wiley and Sons 2007.
2 Raghavan.V “Materials Science and Engineering”, Prentice Hall of India Pvt., Ltd., 2007.
3 Sydney H.Avner “Introduction to Physical Metallurgy” McGraw Hill Book Company, 2007.
4 Dieter G. E., Mechanical Metallurgy, Mc Graw Hill Book Company, 1988.
5 O.P. Khanna, A text book of Materials Science and Metallurgy, Khanna Publishers, 2003.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15008	PRODUCT DESIGN AND DEVELOPMENT	3	0	0	3	100

Objective(s)

- To study the basic concepts of product design and development process.
- To study the key reasons for design or redesign.
- To study the applicability of product design and development for different applications.
- To know the rules and principles for manufacturing and assembling of a new product.
- Undertake a methodical approach to the management of product development to satisfycustomer needs.

Outcome(s)

The students will be able to

1. Select an appropriate product design and development process for a given application.
2. Define the components and their functions of product design and development processes andtheir relationships from concept to customer over whole product lifecycle.
3. Analyze, evaluate and apply the methodologies for product design and development.
4. Apply design rules for material selection, design for manufacturability and design forassembly.
5. Recognize issues of product safety, risk, and reliability.

UNIT-I	NEW PRODUCT DEVELOPMENT	(9)

Product development – Trends– Best practices– Product development process and organizations – Collaborative product development – Time compression Technologies – risk management – Stages of Product development.Conceptual / Industrial / Engineering design. Design analysis and validation.

UNIT-II	CONCEPTUAL DESIGN	(9)

Early design – Customer needs – Requirement Definition and Conceptual design – Optimization using cost and utility metrics – Trade-off analysis- models and parameters design to cost – Design to Life cycle cost – Design for warranties-problem solving – Benchmarking.

UNIT-III	PRODUCT DESIGN EVALUATION	(9)

Detailed design – Analysis and modeling – Best practices for detailed design – Design analyses – Prototypes in detailed design – Test and Evaluation – Design review, prototyping – simulation and testing – Manufacturing – Strategies – planning and methodologies.

UNIT-IV	DESIGN FOR MANUFACTURE AND ASSEMBLY	(9)

General design principles for manufacturability – strength and mechanical factors, mechanism selection- process capability – Feature tolerances – Geometric tolerances – Assembly limits – Datum features – Tolerance stacks –Problems on tolerancing – Exposure on DFMA software.

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Mallasamudram, Namakkal

UNIT-V	DESIGN FOR UNKNOWN	(9)
Simplification – commonality and preferred methods – Modularity and scalability – part reduction – functionalanalysis and value engineering – Reliability – Strategies and practices – Testability – Design for test and inspection. Design for people – Ergonomics, Reparability, Maintainability, safety and product liability.		
	Total hours to be taught	**45 Periods**

TEXT BOOK:

1.	Karl T. Ulrich and Steven D. Eppinger. "Product Design and Development" Tata McGraw-Hill PublishingCompany Limited, 2003

REFERENCES:

1.	Stephen C. Armstrong, "Engineering and Product development Management– The Holostic Approach"Cambridge University Press, 2001.
2.	Ibrahim Zeid, "Mastering CAD/CAM" Tata McGraw-Hill, 2005.
3.	Corrodo Poli, "Design for Manufacturing: A structured approach", Butterworth- Heinemann, 2001.
4.	John W. Priest and Jose M. Sanchez, "Product development and design for manufacturing- A collaborativeapproach to Produciability and reliability", Marcel Dekker Publications, 2001.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15009	SAFETY ENGINEERING	3	0	0	3	100

Objective(s)	• To impart knowledge on safety engineering fundamentals and safety management practices. • To demonstrate knowledge of hazards associated with chemical • To know the safety procedures and obligations that applies to their workplace environment and the guidelines for safety regulations. • To achieve maximum safety by minimizing, eliminating, or establishing control over significant risks.
Outcome(s)	The students will be able to 1. Assess the severity of the consequences of incidents. 2. Undertake a Hazard and Operability Study. 3. Explain the legal framework controlling process plant safety in industrialized countries. 4. Demonstrate how the root cause of incidents can be investigated and analyzed and the various human and technical aspects of such causes. 5. Distinguish the typical sources of risk in a process plant by hazard identification and examination of case studies.

UNIT-I	**INTRODUCTION**	**(9)**
Evolution of modern safety concepts – Fire prevention – Mechanical hazards – Boilers, Pressure Vessels, Electrical Exposure.		
UNIT-II	**CHEMICAL HAZARDS**	**(9)**
Chemical exposure – Toxic materials – Ionizing Radiation and Non-ionizing Radiation – Industrial Hygiene – Industrial Toxicology.		
UNIT-III	**ENVIRONMENTAL CONTROL**	**(9)**
Industrial Health Hazards – Environmental Control – Industrial Noise - Noise measuring instruments, Control of Noise, Vibration, - Personal Protection.		
UNIT-IV	**HAZARD ANALYSIS**	**(9)**
System Safety Analysis –Techniques – Fault Tree Analysis (FTA), Failure Modes and EffectsAnalysis (FMEA), HAZOP analysis and Risk Assessment.		
UNIT-V	**SAFETY REGULATIONS**	**(9)**
Explosions – Disaster management – catastrophe control, hazard control, Safety education andtraining - Factories Act, Safety regulations Product safety – case studies.		
	Total hours to be taught	**45 Periods**

TEXT BOOK :

1 John V.Grimaldi, “Safety Management”, AITB S Publishers, 2003.

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REFERENCES:	
1	Safety Manual, "EDEL Engineering Consultancy", 2000.
2	David L.Goetsch, "Occupational Safety and Health for Technologists", 5th Edition, Engineers and Managers, Pearson Education Ltd., 2005.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15010	POWER ELECTRONICS	3	0	0	3	100

Objective(s)	• To get an overview of different types of power semiconductor devices and theirswitching characteristics. • To understand the operation, characteristics and performance parameters ofcontrolled rectifiers. • To study the operation, switching techniques and basics topologies of DC-DCswitching regulators. • To learn the different modulation techniques of pulse width modulated invertersand to understand harmonic reduction methods. • To study the operation of AC voltage controller and various configurations.
Outcome(s)	The students will be able to 1. Realize the Characteristics of Power Semiconductor Devices. 2. Investigate and design the power converter circuits for AC-DC. 3. Analyze the DC-DC converter circuits for real time application. 4. Capability to design the inverter circuits. 5. Examine voltage controllers.

UNIT-I	**POWER SEMI-CONDUCTOR DEVICES**	**(9)**
Study of characteristics of switching devices, Diode, SCR, TRIAC, GTO, BJT, MOSFET, IGBT- Static andDynamic characteristics - Triggering and commutation circuit for SCR- Design of Driver and snubber circuit.		
UNIT-II	**AC-DC CONVERTERS**	**(9)**
Controlled and uncontrolled rectifiers (single phase and three phase) – power factor, harmonics – active frontend rectifiers.		
UNIT-III	**DC-DC CONVERTERS**	**(9)**
Introduction – linear mode power conversion – switched mode power conversion – buck converter, boost converter, buck-boost converter, Cuk converter - Isolated converters: forward converter, fly back converter –Introduction to resonant converters.		
UNIT-IV	**DC-AC CONVERTERS**	**(9)**
Introduction - voltage source inverter - current source inverter - square wave and PWM inverters (single phaseand three-phase) – PWM techniques.		
UNIT-V	**AC TO AC CONVERTERS**	**(9)**
Single phase and Three phase AC voltage controllers–Control strategy- Power Factor Control – Multistagesequence control – single phase and three phase cyclo converters –Introduction to Matrix converters.		
Total hours to be taught		**45 Periods**

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TEXT BOOKS:	
1	Muhammad H.Rashid, 'Power Electronics: Circuits, Devices and Applications', Prentice Hall of India, Pearson Education, 4th Edition, 2013.
2	P.S.Bimbra,'Power Electronics', Khanna Publishers, 5th Edition, 2012.
3	L. Umanand, 'Power Electronics Essentials and Applications', Wiley, 2010.
REFERENCE:	
1	Joseph Vithayathil, 'Power Electronics, Principles and Applications', McGraw Hill Series, 6th Reprint,2013.
2	Ashfaq Ahmed, 'Power Electronics for Technology Pearson Education', Indian reprint, 2003.
3	Philip T. Krein, 'Elements of Power Electronic', Oxford University Press, 2004 Edition.
4	Ned Mohan, Tore. M. Undel and, William. P. Robbins, 'Power Electronics: Converters, Applications and Design ', John Wiley and sons, third edition, 2003.
5	M.D. Singh and K.B. Khanchandani, 'Power Electronics', Mc Graw Hill India, 2013.

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Department	MECHATRONICS	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15011	SMART MANUFACTURING	3	0	0	3	100

Objective(s)	• To Learn about Internet of Things (IoT). • To provide a depth knowledge of Smart Manufacturing. • To address the underlying concepts and methods behind Smart Manufacturing. • To provide a comprehensive knowledge on the role of data, manufacturing systems, various smart manufacturing technologies and applications. • To understand the opportunities and challenges brought about by Smart Manufacturing.
Outcome(s)	On successful completion of the course, the students will be able to • Analyze the power of Cloud Computing in a networked economy • Identify different areas of IOT and Smart Manufacturing. • Outline the various systems used in a manufacturing plant and their role in a smart Manufacturing. • Predict the smartness in Smart Factories, Smart cities, smart products and smart services. • Find how organizations and knowledge workers can be better prepared to reap the benefits of this latest revolution.

UNIT-I	**THE INTERNET OF THINGS**	**(9)**
An overview; Design Principles for Connected Devices; Internet Principles. Automatic Storage Management in a Cloud World – Introduction to Cloud, Relational Databases in the Cloud, Automatic Storage Management in the Cloud.		
UNIT-II	**INTRODUCTION TO SMART MANUFACTURING**	**(9)**
Smart manufacturing – Definition, components, Smart Manufacturing Vs. conventional/legacy manufacturing- Smart Manufacturing Processes - Three Dimensions: Demand Driven and Integrated Supply Chains - Dynamically Optimized Manufacturing Enterprises (plant + enterprise operations) - Real Time, Sustainable Resource Management (intelligent energy demand management, production energy optimization and reduction of GHG).		
UNIT-III	**SMART DESIGN/FABRICATION**	**(9)**
Smart Design/Fabrication - Digital Tools, Product Representation and Exchange Technologies and Standards, Agile (Additive) Manufacturing Systems and Standards. Mass Customization, Smart Machine Tools, Robotics and Automation (perception, manipulation, mobility, autonomy), Smart Perception – Sensor networks and Devices.		
UNIT-IV	**SMART APPLICATIONS**	**(9)**
Online Predictive Modeling, Monitoring and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes; Smart Energy Management of manufacturing processes and facilities.		

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Mallasamudram, Namakkal

UNIT-V	SMART AND EMPOWERED WORKERS	(9)
Eliminating Errors and Omissions, Deskilling Operations, Improving Speed/Agility, Improving Information Capture/Traceability, Improving Intelligent Decision Making under uncertainty Assisted/Augmented Production, Assisted/Augmented Assembly, Assisted/Augmented Quality, Assisted/Augmented Maintenance, Assisted/Augmented Warehouse Operations and Assisted Training.		
	Total hours to be taught	**45 Periods**

TEXT BOOK:

1	A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013, ISBN-10: 111843062X.

REFERENCE:

1	N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013.
2	M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010.

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Department	Mechatronics	Programme Code	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15012	DESIGN OF MECHATRONICS SYSTEM	3	0	0	3	100

Objective(s)	• To study basic design parameters of mechatronics system. • To understand and design the mechatronics model and simulation. • To know the real time interfacing for data transfer. • To study the calibration and working of mechatronics system. • To know the various application of mechatronics system.
Outcome(s)	Student will be able to • Design parameters of mechatronics system. • Understand and design the mechatronics model and simulation. • Know the real time interfacing for data transfer. • Study the calibration and working of mechatronics system. • Know the various application of mechatronics system.

UNIT-I	**INTRODUCTION TO MECHATRONICS SYSTEM**	**(9)**
Key elements – Mechatronics Design process –Design Parameters – Traditional and Mechatronics designs –Advanced approaches in Mechatronics - Industrial design and ergonomics, safety.		
UNIT-II	**SYSTEM MODELLING**	**(9)**
Introduction – model categories – fields of application – model development – model verification –modelvalidation – model simplification – Simulators and Simulation.		
UNIT-III	**REAL TIME INTERFACING**	**(9)**
Introduction – selection of interfacing standards – Elements of Data Acquisition & control Systems – Over view of I/O process, General purpose I/O card and its installation – Data conversion process - Application software - Lab view Environment and its applications, Vim-Sim Environment & its applications.		
UNIT-IV	**CASE STUDIES ON MECHATRONIC SYSTEM**	**(9)**
Testing of transportation surface materials – Transducer calibration system for automotive application – Straingauge weighing system – Solenoid force-displacement calibration system – Rotary optical encoder – controlling temperature of hot/cold reservoir.		
UNIT-V	**CASE STUDIES: DATA ACQUISITION AND CONTROL**	**(9)**
Thermal cycle fatigue at a ceramic plate – PH control system – De-icing temperature control system – Skipcontrol of a CD player – Auto focus camera – Pick and place robot – Car park barrier – Car engine management.		
Total hours to be taught		**45 Periods**

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TEXT BOOKS:	
1	Devdasshetty, Richard A. Kolk, “Mechatronics System Design”, 2nd Edition, Cengage Learning 2011.
2	Georg pelz, "Mechatronic Systems: Modeling and simulation" with HDL’s, John wiley and sonsLtd,2003.
REFERENCE:	
1	Bishop, Robert H, "Mechatronics Hand book", CRC Press, 2002.
2	Bradley, D.Dawson, N.C. Burd and A.J. Loader, "Mechatronics: Electronics in Products andProcesses", CRC Press 1991 , First Indian print 2010.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15013	INDUSTRIAL ELCTRONICS ANDAPPLICATIONS	3	0	0	3	100

Objective(s)	• Students will be exposed to electronics devices and their controls used in industrial environment.
Outcome(s)	The students will be able to design various electronic industrial controllers.

UNIT-I	**INTRODUCTION**	**(9)**

Industrial control classification- motion and process control- feed forward control-interfacing devicesOperational Amplifier-review of thyristor- SCR- TRIAC-Phototransistor.

UNIT-II	**CONVERTERS AND INVERTERS**	**(9)**

Analysis of controlled and fully controlled converters-Dual Converters-Analysis of voltage source and currentsource- current source and series converters.

UNIT-III	**INDUSTRIAL MOTOR CONTROL**	**(9)**

Method of controlling speed- Basic control circuit-DC motor control- AC motor control- Servo motor control-Stepper motor control- micro controller-based speed control – solid state motor control-PLL control of a DC motor control.

UNIT-IV	**RELAYS, HEATING & WELDING CONTROL**	**(9)**

Introduction- principle of relays- electromechanical relay- solid state relays- Latching relays timing relays-Induction heating- dielectric heating- resistance welding.

UNIT-V	**PROCESS AND MOTION CONTROL**	**(9)**

Elements of process control- temperature control- Flow control- Level control- Methods of motion control-feedback control- Direct digital control.

Total hours to be taught	**45 Periods**

TEXT BOOK:

1	Chitode .J.S " Industrial Electronics " Technical Publications ,2009.

REFERENCE:

1	Terry Baltelt, "Industrial electronics, devices, systems and applications", Delmar publishers.
2	Stephan L.Herman, Walter N.Alerich, "Industrial Motor Control", fourth edition, Delmar publishers,1998.
3	Biswanath Paul, "Industrial Electronics and Control" Prentice Hall India publisher – 2004.
4	P.Harrott- "Process Control"- Tata McGraw Hill-1991.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15014	EMBEDDED SYSTEM DESIGN	3	0	0	3	100

Objective(s)

The student should be able to

- Provide knowledge on the basics, building blocks of Embedded System.
- Discuss Input/output Interfacing & Bus Communication with processors.
- Teach automation using scheduling algorithms and Real time operating system.
- Design and model the hardware / software approach.
- Discuss on different Phases & Modeling of a new embedded product.

Outcomes

On the successful completion of the course, students will be

1. **Illustrate** the basic concepts of Embedded Systems.
2. **Describe** the devices and buses used in embedded networking.
3. **Explain** the processor scheduling algorithms.
4. **Determine** the embedded hardware and software development cycles and tools.
5. **Develop** programming skills in embedded systems for various applications.

UNIT-I	INTRODUCTION TO EMBEDDED SYSTEMS	(9)

Introduction to Embedded Systems –built in features for embedded Target Architecture - selection of Embedded processor – DMA- memory devices – Memory management methods-memory mapping, cache replacement policies- Timer and Counting devices, Watchdog Timer, Real Time Clock- Software Development tools-IDE, assembler, compiler, linker, simulator, debugger, In circuit emulator, Target Hardware Debugging- Overview of functional safety standards for embedded systems.

UNIT-II	EMBEDDED NETWORKING BY PROCESSORS	(9)

Embedded Networking: Introduction, I/O Device Ports & Buses- multiple interrupts and interrupt service mechanism – Serial Bus communication protocols -RS232 standard–RS485–USB–Inter Integrated Circuits (I2C)- CAN Bus –Wireless protocol based on Wifi , Bluetooth, Zigbee – Introduction to Device Drivers.

UNIT-III	RTOS BASED EMBEDDED SYSTEM DESIGN	(9)

Introduction to basic concepts of RTOS- Need, Task, process & threads, interrupt routines in RTOS, Multiprocessing and Multitasking, Preemptive and non-preemptive scheduling, Task communication-context switching, interrupt latency and deadline shared memory, message passing-, Inter process Communication – synchronization between processes-semaphores, Mailbox, pipes, priority inversion, priority inheritance, comparison of Real time Operating systems: VxWorks, uC/OS-II, RT Linux.

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Mallasamudram, Namakkal

UNIT-IV	MODELLING WITH HARDWARE/SOFTWARE DESIGN APPROACHES	(9)

Modeling embedded systems- embedded software development approach --Overview of UML modeling with UML, UML Diagrams-- Hardware/Software Partitioning, Co-Design Approaches for System Specification and modeling- Co Synthesis- features comparing Single-processor Architectures & Multi-Processor Architectures--design approach on parallelism in uniprocessors & Multiprocessors.

UNIT-V	EMBEDDED SYSTEM APPLICATION DEVELOPMENT	(9)

Objective, Need, different Phases & Modeling of the EDLC, choice of Target Architectures for Embedded Application Development-for Control Dominated-Data Dominated Systems-Case studies on Digital Camera, Adaptive Cruise control in a Car, Mobile Phone software for key inputs.

Total hours to be taught	45 Periods

TEXT BOOKS :

1	Peckol, “Embedded system Design”, John Wiley & Sons,2010.
2	Lyla B Das,” Embedded Systems-An Integrated Approach”, Pearson, 2013.
3	Shibu. K.V, “Introduction to Embedded Systems”, 2e, Mc graw Hill, 2017.

REFERENCES:

1	Raj Kamal, ‘Embedded System-Architecture, Programming, Design’, Mc Graw Hill, 2013.
2	C.R.Sarma, “Embedded Systems Engineering”, University Press (India) Pvt. Ltd, 2013.
3	Tammy Noergaard, “Embedded Systems Architecture”, Elsevier, 2006.
4	Han-Way Huang, “Embedded system Design Using C8051”, Cengage Learning, 2009.
5	Rajib Mall “Real-Time systems Theory and Practice” Pearson Education, 2007.

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Department	Mechatronics	Programme Code	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15015	MEDICAL MECHATRONICS	3	0	0	3	100

Objective(s)	• To study how to measure biochemical and various physiological information. • To know the need and technique of electrical safety in Hospitals. • To study the use of radiation for diagnostic and therapy. • To study the various monitoring instruments used in medical • To study about recorders and advanced equipment in medicine.
Outcome(s)	Students should be able to 1. Study how to measure biochemical and various physiological information. 2. Know the need and technique of electrical safety in Hospitals. 3. Study the use of radiation for diagnostic and therapy. 4. Study the various monitoring instruments used in medical. 5. Study about recorders and advanced equipment in medicine.

UNIT-I	**INTRODUCTION**	**(9)**

Cell structure – electrode – electrolyte interface, electrode potential, resting and action potential – electrodes fortheir measurement, ECG, EEG, EMG – machine description – methods of measurement – three equipment failures and trouble shooting.

UNIT-II	**BIO-MEDICAL SENSORS AND TRANSDUCERS**	**(9)**

Basic transducer principles Types – source of bioelectric potentials – resistive, inductive, capacitive, fiber-optic,photoelectric and chemical transducers – their description and feature applicable for biomedical instrumentation – Bio & Nano sensors & application

UNIT-III	**SIGNAL CONDITIONING, RECORDING AND DISPLAY**	**(9)**

Input isolation, DC amplifier, power amplifier, and differential amplifier – feedback, op-Amp electrometer amplifier, carrier Amplifier – instrument power supply – electron microscope – PMMC writing systems – Telemetry principles – Bio telemetry.

UNIT-IV	**MEDICAL SUPPORT**	**(9)**

Electrocardiograph measurements – blood pressure measurement: by ultrasonic method – plethysonography – blood flow measurement by electromagnetic flow meter cardiac output measurement by dilution method – phonocardiography – vector cardiography. Heart lung machine – artificial ventilator – Anesthetic machine – Basic ideas of CT scanner – MRI and ultrasonic scanner – Bio-telemetry – laser equipment and application – cardiac pacemaker – DC– defibrillator patient safety - electrical shock hazards. Centralized patent monitoring system.

UNIT-V	**RECORDERS AND ADVANCED SYSTEMS**	**(9)**

Oscillagraphic – galvanometric - thermal array recorder, photographic recorder, storage oscilloscopes, electronmicroscope. Biotelemetry, Diathermy, Audiometers, Dialyzers, Lithotripsy.

Total hours to be taught	**45 Periods**

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TEXT BOOKS:	
1	SiamakNajarian "Mechatronics in Medicine – A Bio medical engg approach" , McGraw – HillEducation, 2011.
2	Cromwell, Weibell and Pfeiffer, "Biomedical Instrumentation and Measurements", 2ndEdition, Printice Hall of india , 1999.
3	Arumugam M., "Bio Medical Instrumentation", Anuradha agencies Pub., 2002.
REFERENCE:	
1	Khandpur, R.S., "Handbook of Biomedical Instrumentation", TMH, 1989.
2	Geddes L.A., and Baker, L.E., "Principles of Applied Bio-medical Instrumentation", 3rd Edition,JohnWiley and Sons, 1995.
3	Tompkins W.J., "Biomedical Digital Signal Processing", Prentice Hall of India, 1998.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15016	ENGINEERING THERMODYNAMICS	3	1	0	4	100

Objective(s)	• The laws of thermodynamics are introduced. • Types of I.C engines, air conditioning and refrigeration techniques and heat transfer methods are introduced.
Outcome(s)	The students will be able to 1. Apply the thermodynamics laws in the design of I.C engines, air conditioning and refrigeration equipment.

UNIT-I	**FIRST LAW OF THERMODYNAMICS**	**(9+3)**

Thermodynamics – microscopic and macroscopic point of view – systems, properties, process, path, cycle. Units – pressure, temperature – Zeroth law. First law – application to closed and open systems, internal energy, specificheat capacities CV and CP – enthalpy.

UNIT-II	**SECOND LAW OF THERMODYNAMICS**	**(9+3)**

Second Law of thermodynamics – statements – equivalents of Kelvin Plank and Clausius statements- Reversibility – Irreversibility, reversible cycle – Carnot cycle and theorem

UNIT-III	**INTERNAL COMBUSTION ENGINES**	**(9+3)**

Classification of IC engine - IC engine components and functions- Valve timing diagram and port timing diagram - Comparison of two stroke and four stroke engines, Comparison of petrol & diesel engine, Fuel supply systems, total fuel consumption, specific fuel consumption, mechanical efficiency, BHP, IHP, FP - Ignition Systems,Lubrication system, Cooling system, MPFI, DTSI, CRDI

UNIT-IV	**REFRIGERATION AND AIR-CONDITIONING**	**(9+3)**

Principles of refrigeration, refrigerator& heat pump cycle, refrigerants, refrigerant properties, refrigerant selection, vapour compression refrigeration cycle, vapour absorption cycle, dry bulb temperature, wet bulb temperature, relative humidity, comfort air-conditioning, Psychometric chart, humidification, de-humidification, air coolers, cooling towers.

UNIT-V	**HEAT TRANSFER (Qualitative Treatment Only)**	**(9+3)**

Heat transfer through conduction and convection, Fourier's law of conduction - Problems on one dimensional heat conduction through plain walls, composite walls, cylinder walls, spheres. Extended surfaces Fins. Problems on heat transfer through rectangular fin, triangular fin, circumferential fin, pin fin, fin efficiency, fin effectiveness. Heat transfer through radiation, Stefan Boltzman Law, black body, grey body, shape factor. Typesof Heat Exchangers.

Total hours to be taught	**60 Periods**

TEXT BOOK:

1 Nag P. K, **'Engineering Thermodynamics'** Tata McGraw-Hill, 2005.

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REFERENCE:	
1	Michael A. Boles, Yunus A. Cengel, Yunus Cengel, **'Thermodynamics'**, 2nd Edition, McGraw-HillIndia, 2006.
2	Dr. C.P. Kothandaraman, S.Domkundwar & A.V.Domkundwar, '**A course in Thermal Engineering**' DHANPATRAI & CO (P) LTD, Fifth edition, 2000.
3	Dr. C.P.Kothandaraman, **'Heat and Mass Transfer',** New Age International (P) Publishers, 2002.
4	Holman.J.P., **'Thermodynamics'**, 3rd Ed. McGraw-Hill, 2000.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15017	MAINTENANCE ENGINEERING	3	0	0	3	100

Objective(s)	• To enable the student to understand principles, functions and practices adaptedin industry for successful management of maintenance activities. • To explain the different maintenance categories like Preventive maintenance,condition monitoring, repair of machine elements. • To illustrate some of the simple instruments used for condition monitoring inindustry. • To study the basic repair methods and Failure analysis. • To enable the student job order and maintenance.
Outcome(s)	The students will be able to 1. Upon completion of the programme, the students can able to implement the maintenance function. 2. Student will able to different practices in industries for the successful managementof maintenance activities. 3. The Student will able to identify the different maintenance categories likePreventive maintenance, condition monitoring. 4. Student will able to repair methods and failure analysis. 5. Student will learn job order and material handling equipment.

UNIT-I	**PRINCIPLES AND PRACTICES OF MAINTENANCE PLANNING**	**(9)**

Basic Principles of maintenance planning – Objectives and principles of planned maintenance activity Type ofmaintenance – Benefits of sound Maintenance systems – Reliability and machine availability – MTBF, MTTR, MTTF and FIT– Factors of availability – Maintenance organization – Maintenance economics.

UNIT-II	**MAINTENANCE POLICIES – PREVENTIVE MAINTENANCE**	**(9)**

Maintenance categories – Comparative merits of each category – Preventive maintenance, maintenanceschedules, repair cycle – Principles and methods of lubrication – TPM.

UNIT-III	**CONDITION MONITORING**	**(9)**

Condition Monitoring – Cost comparison with and without CM – On-load testing and offload testing – Methodsand instruments for CM – Temperature sensitive tapes – Pistol thermometers – wear-debris analysis.

UNIT-IV	**REPAIR METHODS FOR BASIC MACHINE ELEMENTS**	**(10)**

Repair methods for beds, slide ways, spindles, gears, lead screws and bearings – Failure analysis – Failures andtheir development – Logical fault location methods – Sequential fault location.

UNIT-V	**REPAIR METHODS FOR MATERIAL HANDLING EQUIPMENT**	**(8)**

Repair methods for Material handling equipment - Equipment records –Job order systems -Use of computers in maintenance.

Total hours to be taught	**45 Periods**

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TEXT BOOKS:	
1.	Srivastava S.K., "Industrial Maintenance Management", – S. Chand and Co., 1981
2.	Venkataraman.K "Maintancence Engineering and Management", PHI Learning, Ltd., 2007
REFERENCE:	
1.	Bhattacharya S.N., "Installation, Servicing and Maintenance", S. Chand and Co., 1995
2.	White E.N., "Maintenance Planning", I Documentation, Gower Press, 1979.
3.	Davies, "Handbook of Condition Monitoring", Chapman &Hall, 1996
4.	"Advances in Plant Engineering and Management", Seminar Proceedings – IIPE, 1996

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15018	ENTREPRENEURSHIP DEVELOPMENT	3	0	0	3	100

Objective(s)	• To develop and strengthen entrepreneurial quality and motivation in students and to impart basic entrepreneurial skills and understanding to run a business efficiently andeffectively.
Outcome(s)	1. Upon completion of the course, students will be able to gain knowledge and skillsneeded to run a business successfully.

UNIT-I	**ENTREPRENEURSHIP**	**(9)**
Entrepreneur – Types of Entrepreneurs – Difference between Entrepreneur and Intrapreneur Entrepreneurship inEconomic Growth, Factors Affecting Entrepreneurial Growth.		
UNIT-II	**MOTIVATION**	**(9)**
Major Motives Influencing an Entrepreneur – Achievement Motivation Training, Self-Rating, Business Games, Thematic Apperception Test – Stress Management, Entrepreneurship Development Programs – Need, Objectives.		
UNIT-III	**BUSINESS**	**(9)**
Small Enterprises – Definition, Classification – Characteristics, Ownership Structures – Project Formulation – Steps involved in setting up a Business – identifying, selecting a Good Business opportunity, Market Survey and Research, Techno Economic Feasibility Assessment – Preparation of Preliminary Project Reports – Project Appraisal – Sources of Information – Classification of Needs and Agencies.		
UNIT-IV	**FINANCING AND ACCOUNTING**	**(9)**
Need – Sources of Finance, Term Loans, Capital Structure, Financial Institution, Management of working Capital,Costing, Break Even Analysis, Taxation – Income Tax, Excise Duty – Sales Tax.		
UNIT-V	**SUPPORT TO ENTREPRENEURS**	**(9)**
Sickness in small Business – Concept, Magnitude, Causes and Consequences, Corrective Measures – Business Incubators – Government Policy for Small Scale Enterprises – Growth Strategies in small industry – Expansion,Diversification, Joint Venture, Merger and Sub Contracting.		
	Total hours to be taught	**45 Periods**

TEXT BOOKS:

1	Khanka. S.S., "Entrepreneurial Development" S.Chand & Co. Ltd.,Ram Nagar, New Delhi, 2013.
2	Donald F Kuratko, " Entreprenuership – Theory, Process and Practice", 9th edition, Cengage Learning, 2014.

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REFERENCE:	
1	Hisrich R D, Peters M P, "Entrepreneurship" 8th Edition, Tata McGraw-Hill, 2013.
2	Mathew J Manimala, Enterprenuership theory at cross roads: paradigms and praxis"Dream tech, 2nd edition 2005.
3	Rajeev Roy, 'Entrepreneurship' 2nd edition, Oxford University Press, 2011.
4	EDII "Faulty and External Experts – A Hand Book for New Entrepreneurs Publishers: Entrepreneurship Development", Institute of India, Ahmadabad, 1986.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum Marks
		L	T	P	C	
22MT15019	QUALITY CONTROL AND RELIABILITY ENGINEERING	3	0	0	3	100

Objective(s)

- To introduce the concept of SQC.
- Demonstrate the ability to design, use, and interpret control charts for attributes andvariables.
- To understand process control and acceptance sampling procedure and theirapplication.
- To learn the concept of reliability.
- To present a problem oriented in depth knowledge of Quality and Reliability Engineering.

Outcome(s)

The students will be able to

1. Understand the concepts of quality control, improvement and management.
2. Prepare and analyze the various charts or methods for quality control and improvement.
3. Use plans for sampling and concepts of quality system management.
4. Understand and carry out reliability data analysis.
5. Can identify different areas of Quality and Reliability Engineering.

UNIT-I INTRODUCTION AND PROCESS CONTROL FOR VARIABLES (10)

Introduction, definition of quality, basic concept of quality, definition of SQC, benefits and limitation of SQC,Quality assurance, Quality control: Quality Cost-Variation in process-causes of variation –Theory of control chart- uses of control chart – Control chart for variables – X chart, R chart and chart - process capability – processcapability studies and simple problems. Six sigma concepts.

UNIT-II PROCESS CONTROL FOR ATTRIBUTES (8)

Control chart for attributes –control chart for non-conforming– p chart and np chart – control chart fornonconformities– C and U charts, State of control and process out of control identification in charts, pattern study.

UNIT-III ACCEPTANCE SAMPLING (9)

Lot by lot sampling – types – probability of acceptance in single, double, multiple sampling techniques – O.C. curves – producer's Risk and consumer's Risk. AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans.

UNIT-IV LIFE TESTING – RELIABILITY (9)

Life testing – Objective – failure data analysis, mean failure rate, mean time to failure, mean time between failure,hazard rate – Weibull model, system reliability, series, parallel and mixed configuration – simple problems. Maintainability and availability – simple problems. Acceptance sampling based on reliability test – O.C Curves.

UNIT-V QUALITY AND RELIABLITY (9)

Reliability improvements – techniques- use of Pareto analysis – design for reliability – redundancy unit and standby redundancy – Optimization in reliability – Product design – Product analysis – Product development – Product lifecycles.

Total hours to be taught **45 Periods**

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TEXT BOOKS:	
1	Douglas.C.Montgomery, " Introduction to Statistical quality control" John wiley 4th edition2001.
2	L.S.Srinath, "Reliability Engineering", Affiliated East west press, 1991.
REFERENCE:	
1	John.S. Oakland. Statistical process control", Elsevier, 5th edition, 2005.
2	Connor, P.D.T.O., "Practical Reliability Engineering", John Wiley, 1993.
3	Grant, Eugene. L "Statistical Quality Control", McGraw-Hill, 1996.

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15020	RENEWABLE AND NON-RENEWABLE ENERGY SOURCES	3	0	0	3	100

Objective(s)

- Providing an overview of Power Plants and detailing the role of Engineers in theiroperation and maintenance.
- Understand the basic concept of Hydro electric energy conversion and its different types.
- To explain the operation of Nuclear Energy System
- Understand the basic concept of solar photovoltaic energy and utilization of renewableenergy sources.
- Understand the basic concept of wind energy and bio mass energy and different types.

Outcome(s)

The students will be able to

1. Get the exposure on Hydroelectric and other conventional sources.
2. Modify the working of power plants and their performance.
3. Predict the types and principles of solar energy.
4. Demonstrate the types and principles of Wind energy.
5. Acquire the knowledge about of Biomass energy.

UNIT-I **INTRODUCTION OF CONVENTIONAL ENERGY SYSTEMS** **(9)**

Coal fired steam thermal power plant – layout, working, T-S diagram of water and steam, rankine cycle for steam turbine, efficiency. Gas turbine power plant – layout, working and T-S diagram for simple and combined cycle power plant, comparison, efficiency.

UNIT-II **HYDRO AND NUCLEAR ENERGY SYSTEMS** **(9)**

Hydro Electric plants: Types, energy conversion schemes, environmental aspects – Hydro-Thermal coordination.Ocean Energy Technology, Tidal energy – Wave energy – Open and closed OTEC Cycles, **Nuclear power plants:** Fuels, Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), CANadaDeuterium-Uranium reactor (CANDU), nuclear waste management.

UNIT-III **SOLAR ENERGY** **(9)**

Energy Conservation and Energy Efficiency – Needs and Advantages, Different types of Renewable Energy Sources. Solar Flat plate and concentrating collectors – Solar heating and cooling techniques – Solar desalination – Solar Pond – Solar cooker – Solar Drying – Solar pumping – Solar thermal power plant – Solar photo voltaic conversion – Solarcells – PV applications.

UNIT-IV **WIND ENERGY** **(9)**

Wind energy conversion, General formula -Lift and Drag- Basis of wind energy conversion – Effect of density, frequency variances, angle of attack, and wind speed. Windmill rotors Horizontal axis and vertical axis rotors. Determination of torque coefficient, Induction type generators- working principle.

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UNIT-V	BIOMASS ENERGY	(9)

Biomass direct combustion – Biomass gasifier – Biomass: Types – Advantages & Drawbacks - Biogas plant – Ethanolproduction — Biomass applications.

Total hours to be taught **45 Periods**

TEXT BOOKS:

1. Power generation engineering by Dr.G.K.Vijayaraghavan, Lakshmi Publication-New Edition.
2. G.D. Rai, Non-Conventional Energy Sources, Khanna Publishers, New Delhi, 1999.
3. S.P. Sukhatme, Solar Energy, Tata McGraw Hill Publishing Company Ltd., New Delhi, 1997.

REFERENCE:

1. G.D.Rai, “Non-conventional energy sources”, Khanna publishers, Fourth Edition, 2004.
2. Abbasik “Renewable Energy Sources and their Environment”, PHI, 2008.
3. G.N. Tiwari, Solar Energy – Fundamentals Design, Modelling and applications, Narosa Publishing House, New Delhi, 2002.
4. Twidell, J.W. & Weir, A., "Renewable Energy Sources", EFN Spon Ltd., UK, 2006.
5. www.nptelvideos.in/2012/11/energy-resources-and-technology.html,
6. https://nptel.ac.in/courses/121106014/3
7. https://nptel.ac.in/downloads/108108078/

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Department	Mechatronics	Programme Code & Name	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15021	BUILDING AUTOMATION	3	0	0	3	100

Objective(s)	This course provides theoretical and practical aspects of implementing automation in industry. This course offers learning of pneumatics/ hydraulics systems, electrical controls and Programmable logic controllers.
Outcome(s)	At the end of the course, students will be able to • Illustrate the need and concept of building automation • Prepare the specification and select components of building automation system • Implement the plan for building automation.

UNIT-I	**INTRODUCTION**	**(6)**

Concept and application of Building Management System (BMS) and Automation, requirements and design considerations and its effect on functional efficiency of building automation system, architecture and components of BMS.

UNIT-II	**FIRE ALARM SYSTEM**	**(12)**

Fundamentals: What is Fire? Fire modes, History, Components, and Principles of Operation.
FAS Components: Different fire sensors, smoke detectors and their types, Fire control panels, design considerations for the FA system.
Field Components, Panel Components, Applications.
FAS Architectures: Types of Architectures, Examples.
FAS loops: Classification of loops, Examples.
Fire Standards: FAS Design procedure in brief, NFPA 72A, BS 5839, IS Concept of IP enabled fire & alarm system, design aspects and components of PA system.

UNIT-III	**ACCESS CONTROL SYSTEM**	**(9)**

Access Control System: Access Components, Access control system Design.
CCTV: Camera: Operation & types, Camera Selection Criteria, Camera Applications, DVR Based system, DVM, Network design, Storage design.
Components of CCTV system like cameras, types of lenses, typical types of cables, controlling system.CCTV Applications.

UNIT-IV	**SECURITY SYSTEMS**	**(9)**

Fundamentals: Introduction to Security Systems, Concepts.
Perimeter Intrusion: Concept, Components, Technology, Advanced Applications. Security Design: Security system design for verticals.
Concept of automation in access control system for safety, Physical security system with components, RFID enabled access control with components, Computer system access control – DAC, MAC, RBAC.

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UNIT-V	ENERGY & BUILDING MANAGEMENT SYSTEM	(9)

ASHRAE Symbols - **Energy Management:** Energy Savings concept & methods, Lighting control, Building Efficiency improvement, Green Building (LEED) Concept & Examples.
Building Management: IBMS (HVAC, Fire & Security) project cycle, Project steps BMS. Verticals: Advantages & Applications of BMS, Examples Integration: IBMS - Architecture, Normal & Emergency operation. Advantages of BMS.

Total hours to be taught	**45 Periods**

REFERENCE:

1. Smart Buildings by Jim Sinopoli, Butterworth-Heinemann imprint of Elsevier,2nd ed., 2010.
2. Understanding Building Automation Systems (Direct Digital Control, Energy Management, Life Safety, Security, Access Control, Lighting, Building Management Programs) by Reinhold A. Carlson, Robert A. Di Giandomenico, pub. by R.S. Means Company,1991.
3. Intelligent Building Systems by Albert Ting-Pat So, WaiLok Chan, KluwerAcademic publisher,3rd ed.,2012.
4. Design of Special Hazards and Fire Alarm Systems by Robert Gagnon, Thomson Delmar Learning; 2nd edition,2007.
5. Process Control- Instrument Engineers Handbook by Bela G. Liptak, Chilton book company.

List of Open Source Software/learning website:

http://nptel.ac.in/video.phphttps://buildingsol

utions.honeywell.com/en-

US/Pages/default.aspxhttp://www.isa.org

http://www.controleng.com/

http://www.schneider-

electric.com/b2b/en/solutions/system/s1/buildings-

systems.jsphttp://www.automation.siemens.com/

http://coep.vlab.co.in/?sub=33&brch=97

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Department	Mechatronics	Programme Code	1101 & MCT

Course code	Course Name	Hours/week			Credit	Maximum marks
		L	T	P	C	
22MT15022	MODELING AND SIMULATION	3	0	0	3	100

Objective(s)	• To explain the basic concepts of building a model, study of simulation andsystems. • To study about the generation of random numbers, testing of random numbers. • To study about the generation of random variables. • To study the concepts of analysis and evaluation of models. • To study about various simulation soft wares.
Outcome(s)	Student should be able to 1.Define the simulation and its importance in creation of models for real time systems. 2.Describe the different types of systems. 3.Simulate the real time systems by generating the random numbers and variables. 4.Design and analyze the model using simulation software packages. 5.Study about various simulation software.

UNIT I	**SYSTEM AND SYSTEM ENVIRONMENT**	**(9)**

Component of a System – Continuous and discrete systems – Types of model; Steps in Simulation study; Simulation of an event occurrence using random number table – Single server queue –two server queues – inventory system.

UNIT II	**RANDOM NUMBER GENERATION**	**(9)**

Properties of random numbers – Generation of Pseudo – random numbers – techniques of generating pseudo random numbers; Test for random numbers: the Chisquare test-the kolmogrov Smirnov test – Runs test – Gaptest – poker test.

UNIT III	**RANDOM – VARIATE GENERATION**	**(9)**

Inverse transform technique for Exponential, Uniform, triangular, weibull, empirical, uniform and discretedistribution, Acceptance rejection method for Poisson and gamma distribution; Direct Transformation for normal distribution.

UNIT IV	**ANALYSIS AND EVALUATION OF MODEL**	**(9)**

Data collection, identifying the distribution, Parameter estimation, goodness of fit tests, verification andvalidation of simulation models.

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UNIT V	SIMULATION SOFTWARE PACKAGES	(9)
Comparison and selection of General Purpose Simulation System *(*GPSS), SIMSCRIPT, SLAM, Arena simulation language, Modeling basic operations using Arena – An Electronic Assembly and testing system, Development of simulation models using Arena simulation package for queuing system, Production system, inventory system, Arena Integration and customization. Simulation Case Study of a Metal-Parts Manufacturing Facility.		
	TOTAL HOURS	**45 Periods**

TEXT BOOK:

1.	Banks J., Carson J.S. and Nelson B.L., "Discrete – Event System Simulation", , Pearson Education, Inc3rd Edition, 2005.

REFERENCE:

1.	David Kelton.W. and Randall P. Sowdowski, "Simulation with Arena", , McGraw Hill, 2nd Edition, 2002.
2.	Geoffrey Gorden, "System Simulation", Prentice Hall of India, 2003.
3.	NarsinghDeo., "System Simulation with Digital Computer", Prentice Hall of India, 2003.

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